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Expression of Interest ES00002496, Kalamazoo County, Michigan

Environmental Assessment

DOI-BLM-Eastern States-M000-2022-0010-EA

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CHAPTER 1. INTRODUCTION

The Eastern States Office (ESO) of the Bureau of Land Management (BLM) conducts competitive sales to lease available oil and gas parcels. Interested parties such as private individuals or companies may file EOIs to nominate parcels for competitive bid and leasing by the BLM. The ESO received an Expression of Interest (EOI) ES00002496 (Note: identified as EOI ES1815 in certain portions of this document; it is the same parcel), nominating approximately 40 acres of Federal mineral estate for potential future oil and gas development located at Michigan Meridian, Township 3 South, Range 9 West, Section 21, W1/2W1/2SE, Kalamazoo County, Michigan, within the BLM Northeastern States District Office (NSDO). A map of the nominated parcel can be found in Appendix A, Map 1. The surface is 100 percent privately owned; 50 percent of the oil and gas mineral estate is privately owned and 50 percent is Federally owned.

1.1. Background

The ESO publishes a Notice of Competitive Lease Sale, which lists lease parcels to be offered, at least 45 days before an auction is held. The BLM National Fluids Lease Sale System (NFLSS) has assigned Parcel Number MI-2023-06-0008 to the nominated parcel for lease sale purposes. Lease stipulations applicable to each parcel are specified in the Sale Notice. Decisions as to which public lands and minerals are open for leasing and what leasing stipulations may be necessary are made during the land use planning process using available information. Constraints on leasing and any future development of split estate parcels are determined by the BLM in consultation with the appropriate surface management agency or the private surface owner.

The BLM will only lease subsurface mineral estate owned by the United States. The NSDO manages the Federal mineral estate underlying 20 states in the Midwest and northeast. The NSDO prepares an analysis for EOIs consistent with the National Environmental Policy Act (NEPA), most commonly in the form of an Environmental Assessment (EA).

The act of leasing would give the lessee(s) exclusive rights for ten years to explore and develop federal oil and gas minerals but does not obligate the lessee to drill a well on the lease or authorize any development or use of the surface of leased lands without further application by the operator and approval by the BLM. In the future, the BLM may receive an Application for Permit to Drill (APD) for a parcel that is leased. If an APD is received, the BLM conducts additional site-specific environmental analysis before deciding whether to approve the APD, and what conditions of approval (COA) should apply to the permit.

1.2. Purpose and Need

The purpose of the Proposed Action is to consider opportunities for private individuals or companies to explore and develop federal oil and gas resources through the BLM's competitive leasing process.

The need of the Proposed Action is to respond to the EOI nominated by outside parties in support of development of oil and natural gas resources that are essential to meeting the nation's future needs for energy, while considering natural and cultural resources. It is the policy of the BLM as mandated by various laws, including the Mineral Leasing Act of 1920, as amended [(30

United States Code [USC] 181 et seq.), the Federal Land Policy and Management Act of 1976 (FLPMA) (43 USC 1701), and the Energy Policy Act of 2005 (42 USC 13201 et seq.) to make mineral resources available for development to meet national, regional, and local needs. The oil and gas leasing program managed by the BLM encourages the sustainable development of domestic oil and gas reserves which reduces the dependence of the United States on foreign sources of energy as part of its multiple-use and sustainable yield mandate.

1.2.1. Decision to be Made

Based on the analysis contained in this EA, the BLM will decide whether to make the lands in proposed EOI ES00002496 available for lease, and if so, under what terms and conditions. Under NEPA, the BLM must determine if there are any significant environmental impacts associated with the Proposed Action warranting further analysis in an environmental impact statement (EIS). The NSDO District Manager is the decision maker who will determine if it is appropriate to sign a Finding of No Significant Impact (FONSI) that would not require further analysis in an EIS. The Eastern States State Director is the decision maker who will decide one of the following:

- To authorize for lease EOI ES00002496 with terms and conditions, or
- To not authorize for lease EOI ES00002496

In this situation, the BLM's authority is limited to federal subsurface mineral resources in its decision-making. Decisions concerning surface disturbance and occupancy on the private surface and/or subsurface resources would be made by the private landowner and operator and would need to comply with all local, State and Federal laws including, but not limited to, the Endangered Species Act (ESA), National Historic Preservation Act (NHPA), and Clean Water Act (CWA). The proposed lease would provide the lessee exclusive rights to explore and develop oil and gas reserves on the lease, although it does not in itself authorize surface disturbing activities or obligate the lessee to drill a well on the parcel in the future.

1.3. Scoping and Issues

The BLM NSDO conducted internal scoping through an Interdisciplinary Team (IDT) composed of the Associate District Manager for Natural Resources, Planning & Environmental Coordinator, Planning & Environmental Specialist, Natural Resources Specialists, Archaeologist, and Geologist that first met to discuss the proposal on August 15, 2022, and continued to meet when necessary to develop the issues and analysis of the potential impacts of the proposed action. Table 1 lists those issues that are analyzed in detail in this EA.

The BLM held a 30-day public scoping period for the EA that began on December 20, 2022 and ended on January 19, 2023. The BLM received 10 comment submissions from four commenters; of these comment submissions, three contained substantive comments. Commenters also submitted various materials, including maps of relevant well locations and corresponding well details, in addition to references to be used as best available science.

The primary topics of concern for commenters were fluid minerals development and air quality/climate change. One commenter requested that the BLM quantify the addition of greenhouse gas (GHG) emissions as a result of this lease sale and reasonably foreseeable future actions and document the likely social cost of carbon resulting from the lease sale. The

commenter stated that the lease sale under this EA should be combined with others recently proposed by the BLM to provide a cumulative impact analysis, for which an EIS would be more appropriate.

One commenter requested that if fluid mineral leases are not to be deferred, the BLM should issue rights-of-ways (ROWs) for renewable energy development commensurate with what are approved for oil and gas.

Commenters also requested that there be robust public outreach related to this process, especially regarding the consultation and engagement of environmental justice communities and tribes that may be affected by future actions related to the lease sale in question. One commenter suggested that 60 days should be available for public review of any draft NEPA document. The commenter also suggested that the BLM include a reduced GHG emissions alternative and a conservation and climate alternative in the range of alternatives. One commenter requested that the BLM address the likely cost of cleanup and remediation resulting from future drilling on the parcels in question, stating that often taxpayers are required to front the costs.

Commenters had concerns about public health and safety, environmental justice, and socioeconomic impacts related to oil and gas leasing. They requested that the BLM take a hard look at and thoroughly analyze all potential effects. Commenters were concerned about adverse effects on water resources and the climate, as well as the degradation of air quality and communities' access to outdoor recreation.

Table 1. Issues Analyzed in Detail.

RESOURCE AND ISSUE #	Issue Statement
Air Quality – Issue #1	How would ambient air quality in the analysis area be affected by air pollutant emissions generated from potential development of leases?
Greenhouse Gases – Issue #2	How would future potential development of leases contribute to greenhouse gas (GHG) emissions and climate change?
Human and Community Impacts – Issue #3	What are the human and ecological health impacts of oil and gas development to landowners and communities from noise, light, aesthetics, and traffic?
Water Withdrawals – Issue #4	How will the amounts of water needed for hydraulic fracturing operations affect the availability of local groundwater and surface water resources?
Water Quality – Issue #5	How will the quality of surface and groundwater resources be affected by oil and gas operations?
Wildlife – Issue #6	How would oil and gas development affect wildlife species?
Socioeconomics – Issue #7	How would the Proposed Action impact the social and economic conditions of the analysis area?

RESOURCE AND ISSUE #	Issue Statement
Environmental Justice – Issue #8	How would development of the two well pad sites within the 40 acres proposed for leasing impact the environmental justice (i.e., populations’ access to clean air and water resources)?
Soils – Issue #9	How would potential future development on the nominated parcel affect soil community and structure?

The BLM included an analysis of GHGs and climate change in Sections 3.1 and 3.2 of this EA, social and economic impacts in Section 3.7, and environmental justice in Section 3.8. The BLM included the rationale for why suggested alternatives were eliminated from consideration in Section 2.3. Combining the EAs into an EIS is outside the scope of this EA’s purpose and need. The BLM will offer public involvement opportunities on the project consistent with regulations and policy and commensurate to the project’s scale.

In November 2021, the Department of the Interior released a report on the Federal Oil and Gas Leasing Program (Report). The Report made specific recommendations to address documented deficiencies in the program to meet three programmatic goals:

- Providing a fair return to the American public and states from federal management of public lands and waters, including for development of energy resources
- Designing more responsible leasing and development processes that prioritize areas that are most suitable for development and that ensure lessees and operators have the financial and technical capacity to comply with all applicable laws and regulations
- Creating a more transparent, inclusive, and just approach to leasing and permitting that provides a meaningful opportunity for public engagement and tribal consultation

The Report also recommends that as an overarching policy, the BLM should ensure oil and gas are not prioritized over other land uses, consistent with the BLM’s multiple-use and sustained-yield mandate. The BLM should carefully consider what lands make the most sense to lease in terms of expected yields of oil and gas, the prospects of earning a fair return for US taxpayers, and conflicts with other uses, such as outdoor recreation and wildlife habitat. The BLM should always ensure it is considering the views of local communities, tribes, businesses, state and local governments, and other stakeholders.

While the leasing decisions for this lease sale will result from the BLM’s exercise of its discretion based on its analysis and review of the record, the decisions are also consistent with the recommendations in the Report, as well as numerous reports issued by the Governmental Accountability Office and Congressional Budget Office. These recommendations include ensuring public participation and tribal consultation, addressing conflicts with other resources, avoiding lands with low potential for oil and gas development, focusing leasing near existing development, and ensuring a fair return to taxpayers. This lease sale and NEPA process include a 30-day comment period on the EA and a 30-day protest period. The BLM is also ensuring tribal consultation.

The BLM's leasing decisions consider comments received during this process; the BLM will further evaluate points raised in any protests received. In identifying parcels for leasing, the BLM has evaluated and worked to avoid potential conflicts with other resources, such as wildlife habitat, including connectivity; areas of cultural importance; and sensitive populations. The BLM has also avoided including low-potential lands, which are less likely to produce oil and gas, by considering the identification of the development potential in resource management planning as well as current information. In addition, the BLM has worked to focus leasing near areas with existing development, which supports infrastructure such as roads and gathering systems that would help to reduce venting and flaring and also helps preserve the resilience of intact public lands and functioning ecosystems.

1.3.1. Oil and Gas Administration

1.3.1.1. Royalty Rate for this Lease Sale

As the steward of onshore federal energy resources, including deposits of oil and gas, the BLM is responsible for balancing conservation, energy production, and generating a fair return to the public for the extraction of public resources. Revenue from federal oil and gas development is distributed to several federal programs; it is also shared with the states in which the oil and gas development occurs. At the same time, energy development can pose significant risks to the environment. The BLM is charged with balancing these competing considerations in a manner that best serves the public interest.

The Inflation Reduction Act (IRA) recently changed the BLM's guidance on EOIs, noncompetitive lease offers, and competitive leases rates. Since August 16, 2022, the IRA rescinded the BLM's authority to issue noncompetitive leases under the MLA by striking 30 United States Code (USC) 226(c), and the BLM will not accept new noncompetitive leases. The BLM will reject all noncompetitive lease applications in their entirety. The IRA also updated the terms for competitive leases. All competitive leases issued on or after August 16, 2022, must include the following terms:

- Royalty Rate: 16.67 percent
- Rental Rate: \$3.00 per acre, or fraction thereof, for the first 2 years; \$5.00 per acre, or fraction thereof, for lease years 3 through 8; and \$15.00 per acre, or fraction thereof, thereafter.

1.3.2 Recent Court Decisions

On February 11, 2022, the United States District Court for the Western District of Louisiana issued an order that, in general, enjoined the Department of the Interior, among other agencies, from taking action in connection with Section 5 of Executive Order (EO) 13990 and the Interagency Working Group (IWG) established by that order relating to the measurement of the social cost of greenhouse gases (SC-GHG).

Because this proposed sale relies on the IWG and Section 5 of the EO, the district court's injunction precluded the Department of the Interior from advancing this and similar proposed sales. On March 16, 2022, the Court of Appeals for the Fifth Circuit stayed the injunction

pending appeal (*State of Louisiana v. Biden*, No. 22-30087, 2022 WL 866282 [5th Cir. Mar. 16, 2022]).

Previously, on January 27, 2022, the United States District Court for the District of Columbia issued a decision in *Friends of the Earth v. Haaland*, vacating offshore oil and gas lease sale 257 because the Department of the Interior did not quantify the effects of that sale on emissions from the foreign consumption of oil and gas, despite (in the court’s view) possessing the tools and methodology to do so (2022 WL 254526 [D.D.C. Jan. 27, 2021]). Given the analysis currently available to the BLM, *Friends of the Earth v. Haaland* does not affect the BLM’s analysis of this proposed lease sale.

Unlike the Bureau of Ocean Energy Management—the agency responsible for sale 257—the BLM has not traditionally used simulation tools like MarketSim (the tool at issue in *Friends of the Earth v. Haaland* and used by the Bureau of Ocean Energy Management in preparation for sale 257) when evaluating effects on foreign consumption from proposed BLM state office lease sales. Indeed, the *Friends of the Earth v. Haaland* court recognized that it had previously upheld the BLM’s decision not to consider foreign effects where the BLM had “refused to quantify emissions resulting from particular lease parcels, and thus could not conceptualize the extent to which the lease sales would contribute to the local, regional, and global climate change” (2022 WL 254526, at *13 n.13 [quotation omitted]).

Likewise, the court ruled against the Bureau of Ocean Energy Management for forgoing the foreign consumption analysis for sale 257 in part because the Bureau of Ocean Energy Management shortly thereafter applied that analysis to a draft NEPA analysis for proposed offshore sale 258. The court’s reasoning does not apply to the BLM, which, as noted above, lacks access to any historic or imminent foreign effects analyses at the level of individual BLM state office lease sales. If and when the BLM undertakes this or similar analyses in the future, it may be appropriate to include and consider that analysis when proposing onshore lease sales.

CHAPTER 2. ALTERNATIVES

This chapter describes the alternatives that will be analyzed in Chapter 3, as well as describes alternatives that were considered and why they were eliminated from detailed analysis.

2.1. Alternative A – No Action Alternative

Under the No Action Alternative, the BLM would not make the subject lands available for competitive bid or lease; the proposed 40 acres of federal mineral estate would not be available for potential future oil and gas development and no new foreseeable oil and gas development would occur on the subject lease parcel. However, in the absence of a land use plan amendment closing the lands to leasing, they could be considered for inclusion in future lease sales. CEQ guidelines (40 Code of Federal Regulations [CFR] 1502) stipulate that the No Action Alternative should be analyzed to assess any environmental consequences that may occur if the Proposed Action is not implemented and to serve as a baseline for comparing impacts of the Proposed Action. Therefore, the No Action Alternative has been retained for analysis in this EA. While the BLM may choose the No Action Alternative, these lands could be renominated in the future, at which time the BLM would re-evaluate them under NEPA and issue a new decision.

2.2. Alternative B – Proposed Action

The BLM NSDO received an EOI nomination from a company to lease a parcel to potentially develop Federal minerals. The BLM proposes to make available for lease at the Eastern States June 2023 Competitive Oil and Gas Lease Sale and for potential future oil and gas development if a lease is issued, approximately 40 acres of Federal minerals underlying privately owned surface (split-estate) located in Climax Township, Kalamazoo County, Michigan. A map of the location of the nominated parcel can be found in Appendix A, Map 1.

This EA summarizes the BLM's analysis of potential environmental impacts from leasing and future development of the approximately 40 acres of Federal minerals within the Hydrologic Unit Code (HUC) 12 HUC 040500010505 Indian Lake-Portage River Watershed. Within the Indian Lake-Portage River Watershed (ILPRW), there are seven smaller rivers and tributaries that make up the HUC 12 ILPRW. Other surrounding HUC 12 watersheds within the four-mile assessment area are identified in Appendix A, Map 6. At the time of leasing, there are many factors that the BLM cannot predict concerning the connected action of drilling and production, including but not limited to:

- whether the lessee will submit an APD, and, if so
- a specific location where the lessee will propose to drill (for example in a farm field or in a woodland, etc.)
- what target formation the lessee will seek to develop
- how many wells will be drilled
- what type(s) of wells will be drilled
- how many well pads will be used
- where an access road will be needed

Should a lease be issued, site-specific analysis of individual wells and roads would occur when a lease holder submits an APD. The APD from the lessee provides the site-specific information needed to determine exactly when, where, why and how the company plans on drilling a well(s).

Reasonably Foreseeable Development Scenario (RFDS)

Before a lease owner or operator occupies or conducts any surface-disturbing activities related to development of this lease to access federal minerals, the BLM must first approve an APD as specified in Title 43 CFR 3162. In an APD, an applicant proposes to drill the well subject to the terms and conditions of the lease. Upon receipt of an APD, the BLM may request and conduct an onsite inspection with the applicant and preferably, the private landowner or surface management agency. The BLM also conducts additional site-specific NEPA analysis and the appropriate consultations under the ESA and NHPA prior to approving the APD. Although there would be no surface disturbance from the action of leasing, this EA utilizes an RFDS (see Appendix B) to address the potential environmental effects from future oil and gas development that would likely occur but are unknown in specific detail at this time. For example, estimates are projected for the likely number of wells to be constructed; however, well locations may change at the APD stage. Estimates of well development and production are intended as an analytical baseline for identifying and quantifying direct, indirect, and cumulative effects of oil and gas

activity, as outlined in the RFDS, and have been considered for analysis in this EA and imply no guarantee of lease issuance or subsequent development.

Table 2-1 shows the RFDS summary of predicted oil and gas activity for EOI-ES00002496. The RFDS analysis considered lands within roughly a four-mile assessment area surrounding the nominated 40-acre parcel in EOI-ES00002496, totaling approximately 35,394 acres (Appendix E, Map 2). The assessment area accounts for possible unconventional wells that could be horizontally drilled from up to four miles away from the nominated parcel and extend into the Federal minerals underlying the surface of the nominated parcel. The RFDS examines area geology and past and present oil and gas activities to evaluate future potential oil and gas activities on the 40-acre parcel for the next 20 years, which is the predicted life of a productive well in the assessment area.

**Table 2-1. EOI-ES00002496 Four-Mile Assessment Area:
Predicted Oil and Gas Exploration, Development, and Surface Disturbance**

Area	Type(s) of Well Constructed	Predicted Wells Per Year (20 years)	Predicted Well Pads (20 years)	Total Predicted Wells (20 years)	Total Surface Disturbance: well pad, access road, utility line	Total Surface Disturbance Acres, Pre-Reclamation (20 years)
EOI-ES00002496 Assessment Area	Conventional Vertical	0.1	2	2	3.4 acres	6.8
EOI-ES00002496 Assessment Area	Unconventional Horizontal	0.3	2	6	4.32 acres	8.64

Source: RFDS (Appendix B)

While the 40-acre parcel is not currently identified as being in a current play or field it is likely that a well drilled on or through the parcel would target oil in the Trenton or Trenton-Black River formations and be considered part of the Climax Field. A review of Michigan's oil and gas database identified no oil and gas wells on the subject 40-acre parcel. A total of 77 oil and gas wells identified within the four-mile assessment area were permitted and/or drilled between 1939 and October 1, 2022. Eighteen wells were identified as producing oil, three wells as producing natural gas, three temporarily abandoned, eight permitted/drilling, one saltwater disposal, 44 wells as abandoned, drilled and abandoned, or plugged. Thirteen oil wells were vertical (conventional) or directional and five were horizontal (unconventional) wells. All producing gas wells were vertical (conventional). Two well fields, the Climax and Wakeshma fields, are located within a four-mile radius of the parcel. Wells associated with the Climax Field are located immediate west and south of the 40-acre parcel. Climax Field wells predominantly are oil wells drilled into the top of the Glenwood Formation but target the Trenton or Trenton-Black River formations. Wakeshma Field wells are located approximately two miles south of the parcel and predominantly target gas in the Clinton formation.

Based on the RFDS, each well pad could accommodate either a single vertical well or up to three horizontal wells. Surface disturbance is estimated to be 3.4 acres for each vertical well pad (or about .04% of the assessment area) and 4.32 acres for each horizontal well pad (about .06% of the assessment area). If two vertical wells are drilled and become productive, it would increase the number of producing oil or gas wells in the four-mile assessment area by approximately 11% and if six horizontal wells become productive by approximately 33%.

The following sections provide a general discussion of possible post-leasing reasonably foreseeable activities. All these activities would require additional site-specific NEPA review and approval.

2.2.1. Connected Action: Drilling and Production

Site-Specific APDs

A lessee is required to submit an APD before conducting any ground-disturbing activities pursuant to the lease. In an APD, an applicant identifies a proposed drill site and provides the BLM with specific details on where, how, and when the applicant proposes to drill the well within the constraints of the lease document. Upon receipt of an APD, the BLM conducts an onsite inspection with the applicant and, if possible, the private landowner or the surface-managing agency. Requirements for analysis and consultation under the NEPA, the Endangered Species Act, and other applicable laws including local and State of Michigan, must also be met at the APD stage.

Well Drilling and Completion Operations

Oil and gas (hydrocarbon) wells are built in two phases – drilling and completion. Wells may be drilled vertically (conventionally) to reach a bottom-hole location that is directly below the pad, directionally to reach an offset location, or horizontally to maximize the length of the production zone in a horizontal geologic formation.

Hydraulic fracturing has been used by oil and natural gas producers since the late 1940s and, for the first 50 years, was mostly used in vertical wells in conventional formations. Hydraulic fracturing is still used in these settings, but technological advances have led to greater use of high-volume hydraulic fracturing (HVHF) to horizontally reach unconventional formations. HVHF is a well completions technique that involves the injection of fluids through a wellbore under pressures great enough to fracture the oil and gas producing formations. About 85% of hydraulic fracturing fluid is generally comprised of water, about 14% proppant (comprised mostly of a particular type of uniformly shaped sand or ceramic beads), and about 1% is composed of various chemicals such as gels, biocides, or acids (FracFocus, 2023). The chemical additives used in hydraulic fracturing fluid amount to about 50,000 gallons for a typical well that uses 5 million gallons of hydraulic fracturing fluid; 5 million gallons of water is equivalent to irrigating 8 acres of corn in a growing season or 0.3 inches of rainfall over one square mile). These chemical additives give the fluid desirable flow characteristics, corrosion inhibition, and other qualities. The proppant holds open the newly created fractures after the injection pressure is released. Oil and gas flow through the fractures and up the production well to the surface.

A drilling plan or plan of operations is a required part of any APD submitted to the BLM to develop a well on a Federal lease and is subject to review by a BLM engineer for compliance

with Onshore Oil and Gas Order No. 2. Onshore Order No. 2 includes well casing, cementing, and testing requirements to ensure the integrity of the well bore. After review, the engineer may determine that additional conditions of approval (COA) are required to supplement the drilling plan.

Transporting drilling equipment, materials, and the workers needed to construct a well pad, drill a well, develop and produce the minerals, and reclaim the drill site would require numerous truck trips to and from the site. Table 2-2 estimates the numbers of truck trips needed for successful drilling operations. Drilling operations could continue 24 hours a day and wells may be drilled in as little as two days or up to and exceeding 30 days.

Table 2-2. Estimated number of one-way loaded trips for a single, horizontal well requiring a vertical and horizontal rig.

Well Pad Activity	Early Well Pad Development (all water transported by truck)	Early Well Pad Development (all water transported by truck)
	Heavy-Duty Truck (as defined in 49 CFR 523.6)	Light Truck (as defined in 49 CFR 523.3)
Drill pad construction	45	90
Rig mobilization	95	140
Drilling fluids	45	
Non-rig drilling equipment	45	
Drilling (rig crew, etc.)	50	140
Completion chemicals	20	326
Completion equipment	5	
Hydraulic fracturing equipment (trucks and tanks)	175	
Hydraulic fracturing water hauling	500	
Hydraulic fracturing sand	23	
Produced water disposal	100	
	Heavy-Duty Truck	Light Truck
Final pad prep	45	50
Miscellaneous	-	85
Total one-way loaded trips per well	1,148	831

Source: ALL Consulting, 2010. Table modified from NYSDEC, 2011 and found in Basu, et al. 2013.

Hydraulic fracturing uses high volumes of water. The quantity of water needed varies based on the type of well completed, site geology and the type of hydraulic fracturing techniques used. The Michigan Department of Environmental Quality (MDEQ), the state agency that permits water withdrawals, considers a vertical well that is hydraulically fractured may use about 50,000 to 100,000 gallons of water while a horizontal well that is hydraulically fractured may use up to 20,000,000 gallons of water or more (MDEQ, 2013). In most cases, water trucks would be used daily to supply water during drilling and, if necessary, completion operations. Water to drill and

complete a well would be hauled or piped from a state permitted source, though it is possible that water could be provided from local groundwater resources, but that would be determined by the state and not the BLM.

Well Construction

Compliance with BLM Onshore Order No. 2 assures wells are appropriately designed and drilled. In addition, in the State of Michigan, the Oil, Gas, and Minerals Division of the Michigan Department of Environment, Great Lakes, and Energy (EGLE) is tasked with administering the statute and rules subject to Part 615, Supervisor of Wells, of the Natural Resources Environmental Protection Act (NREPA), 1994, PA 451, as amended (Michigan Legislature, 2023). Hydraulic fracturing activities are specifically addressed in Michigan Administrative Code Rule R 324.1401-1406.

Well construction—casing and cement design—are tailored to the geologic characteristics of the area and are designed to provide effective isolation of groundwater and mineral deposits, to control formation pressures that may be encountered, and to provide a single pathway for oil and gas to be produced to the surface. To ensure the effective isolation of any potentially usable groundwater aquifer, a continuous string of steel pipe (or “casing”) known as the “surface” casing is placed in the well, extending from the surface to at least 100 feet below the bottom of the aquifer. The entire length of that casing string is then cemented into place. The casing is then pressure tested to ensure there are no leaks before deeper drilling resumes. The casing must meet the requirements established in Michigan Administrative Code Rule R 324.410(3).

After drilling deeper, a second string of casing known as “intermediate” casing could be run, if needed, to isolate water flows, high-pressure zones or lost circulation zones. Intermediate casing is typically cemented along its entire length, back to surface. Whether an intermediate casing string will be run is typically known and planned for prior to drilling.

Drilling then continues to the well’s planned total depth. If indications of the well’s productivity were positive, another string of steel “production” casing would be run and cemented into place. A sufficient volume of cement would be used to extend above any potentially productive zone to ensure that, following completion of the well, produced fluids can only flow into the cased well.

All flowback and produced fluids are required to be properly contained. In Michigan, this means steel tanks with secondary containment. Open pit storage of these fluids is prohibited. These fluids are ultimately disposed in deep injection wells that are permitted specifically for that purpose and are protective of freshwater resources (EGLE, 2020a). Drill cuttings would be contained on location during drilling operations and depending on a variety of conditions including surface geology and drill fluid and drill cuttings composition; cuttings would be disposed of on location as part of the interim reclamation program or would be transported to an State-approved Class II underground deep injection well disposal facility (pursuant to Michigan Administrative Code Rule R 324.101- R 324.1406). Drilling spoils would also be hauled to a State-approved disposal facility.

If the well is determined to be capable of producing in sufficient quantity to justify the expense, then the well would be completed as a producing well. A completed well may have a pump jack (for oil), a power source, and piping to storage tanks. A completed well may also require treatment facilities to separate the water from the oil.

Well Production, Abandonment, and Reclamation

If wells were to go into production, facilities would typically be located on the well pad and would require no additional surface disturbance. The production facility for natural gas typically consists of a wellhead, separator, dehydrator, meter house, and a storage tank with truck load-out for produced water. A gas well location may also include a flare that would be used during well maintenance. Michigan allows flaring of natural gas under certain conditions, as defined in flaring and venting related sections of Part 615: Michigan Administrative Code Rules R 324-506, R 324- 610, R 324-1002(m), R 324-1010, R 324-116, R 324-1122, and R 324-1123. Venting and flaring is also regulated by the BLM under NTL-4A. A typical production facility for an oil well consists of a wellhead, pump jack, and storage tanks with truck load-out for oil and produced water. In some instances where production from a well is both oil and gas, the facilities noted for both oil and gas wells would be located on the well pad.

If oil is produced, the oil would be stored on location in tanks and transported off lease by truck to market. The volume of tanker truck traffic for oil production would be dependent upon production of the wells. If natural gas is produced, construction of a gas sales pipeline would be necessary to transport the gas to market.

Production would continue for as long as the well is providing economically sufficient quantities of hydrocarbons. Traffic volumes during production would be dependent upon whether the wells produced natural gas and/or oil, and for the latter, the volume of oil produced. Well maintenance operations may include periodic use of workover rigs that use stimulation techniques to restore or improve production levels, heavy trucks for hauling equipment to the producing well, and inspections of the well by a pumper on a regular basis or by remote sensing. The road and the well pad would be maintained for reasonable access and working conditions.

Along with the oil and/or gas, produced water is expected during the productive life of the well, and separation, dehydration and other production processing may be necessary. This processing may require construction of temporary facilities, both on- and off-site. Disposal of produced water is regulated by BLM Onshore Order No. 7. Oil or gas field fluid wastes may be injected into State of Michigan approved Class II underground deep injection wells, in accordance with State and Federal regulations in a manner that prevents waste.

Interim reclamation would be conducted on areas of the well pad, access roads, and pipelines not needed for production operations, as specified in the approved APD. The following sequence is typical of interim reclamation:

1. The well pad would be reduced to the minimum area necessary to safely conduct production operations. Interim reclamation areas would be re-contoured, topsoil would be replaced, and a seed mix appropriate to the site would be drilled seeded or broadcast across the prepared areas.
2. Access roads to the well pad would be reclaimed to the edge of the driving surface.
3. Trees cleared during site preparation and large rocks excavated during construction would be scattered across the interim reclamation area.

The goal of interim reclamation is to achieve, to the extent possible, final State of Michigan and BLM reclamation standards including re-contouring to achieve the original contour and grade, or

a contour that blends with the surrounding topography; and the establishment of a self-sustaining, vigorous native and/or desirable vegetation community with a density sufficient to provide a stable soil surface.

If a well does not produce economic quantities of oil or gas, or when it is no longer commercially productive, the well would be plugged and abandoned in accordance with procedures contained in BLM Onshore Order No. 2 and approved by a BLM Petroleum Engineer. All equipment would be removed from the location and the well pad, access roads, and pipelines would be subject to final reclamation.

The following sequence is typical of final reclamation:

1. In accordance with BLM Onshore Order No. 1, earthwork for interim and/or final reclamation, would be completed within six months of well completion or abandonment.
2. All weather surfacing material would be removed.
3. As appropriate, topsoil would be salvaged and reserved for final reclamation.
4. Re-contouring, spreading of salvaged topsoil, seed bed preparation, seeding, and scattering trees (woody debris) would be conducted all areas disturbed by well pads, access roads, and pipelines.

On private lands, the BLM may recommend reclamation measures, but the responsibility for implementing reclamation activities falls to the landowner.

The goal of final reclamation is to restore all areas of the well pad and access roads to the original landform or a landform that blends with the surrounding landform, and the establishment of a self-sustaining, vigorous, diverse native and/or desirable vegetation community with a density sufficient to provide a stable soil surface and inhibit non-native plant invasion (p. 43) (BLM, 2007).

Design Features

The BLM issues oil and gas leases for an initial 10-year period. These leases continue thereafter if oil or gas is produced in paying quantities. If a lessee fails to produce oil and gas, does not make annual rental payments, does not comply with the terms and conditions of the lease, or relinquishes the lease, then ownership of the minerals reverts to the federal government.

Standard lease terms and conditions provide for reasonable measures to minimize adverse impacts to specific resource values, land uses, or users and can be found in BLM Form 3100-11, Offer to Lease and Lease for Oil and Gas. Compliance with valid, nondiscretionary statutes (laws) is included in the standard lease terms. Stipulations to protect other surface and subsurface resources would also apply and are described in Appendix D. The lease would also be subject to regional, State, and local regulations governing the conditions for development of the surface of oil and gas leases.

2.3. Alternatives Considered but Eliminated from Detailed Analysis

No feasible alternative surface locations were identified for the proposed project that would result in less impacts than the proposed locations. The public suggested other alternatives

described below; however, those alternatives would not meet the EA's purpose and need, or the effects would be the same as effects from an alternative already being analyzed. As a result, the BLM did not consider any other alternatives aside from the Proposed Action and the No Action Alternative.

2.3.1. Greenhouse Gas Emissions Reduction Alternative

A commenter suggested that the BLM analyze a reasonable alternative that would reduce GHG emissions relative to baseline conditions and include mitigation measures to reduce or avoid climate effects. Such an alternative is beyond the scope of this proposal. The mitigations suggested must be implemented through regulatory action that cannot be implemented through a decision made at the leasing stage. The analysis and subsequent findings and decisions are based on the impacts that consider the mitigation strategies available to the authorized officer.

2.3.2. Conservation and Climate Alternative

A commenter suggested that the BLM consider at least one conservation and climate alternative. The commenter stated that this alternative would "entail substantial deferrals" based on screening the lease for impacts on conservation and the climate. Because this alternative suggests deferring the leases, this alternative would have the same effects as the No Action Alternative; it does not require an analysis.

2.4. Conformance

The Proposed Action of leasing and alternatives are in conformance with the Michigan Resource Management Plan (RMP) (BLM, 1985). Section II, Minerals Development, number 1 of the Michigan RMP states, "All Federal mineral ownership is available for exploration and development except where legal restrictions, intergovernmental consistency requirements, administrative or Congressional designations, or surface resource sensitivity prohibit such activities" (p. 3).

In addressing environmental considerations of the Proposed Action, the BLM is guided by relevant statutes, their implementing regulations, and Executive Orders that establish standards and provide guidance on environmental and natural resources management and planning. In Michigan, all oil and gas exploration and development on state and private land is regulated by the EGLE, Oil, Gas, and Minerals Division. The lease is subject to all applicable existing or subsequent Federal, State and county laws and rules. The key laws, regulations, policies, or orders that are directly related to the project include but are not limited to the following:

- Mineral Leasing Act of 1920, as amended (MLA) – enables leasing of public lands for developing deposits of coal, petroleum, natural gas, and other hydrocarbons as is proposed.
- Federal Land Policy and Management Act of 1976 (FLPMA) – enables the BLM to consider the disposal and sale of public lands through different mechanisms.
- CWA of 1972, as amended – establishes objectives to restore, maintain, and improve the chemical, physical, and biological integrity of the nation's water.

CHAPTER 3. AFFECTED ENVIRONMENT AND ENVIRONMENTAL IMPACTS

The sale of parcels and issuance of oil and gas leases is an administrative action. Nominated parcels are reviewed under the approved Resource Management Plan (RMP), and stipulations are attached to mitigate any known environmental or resource conflicts that may occur on a proposed lease parcel. On-the-ground impacts would not occur until a lessee or their designated operator applies for and receives approval to undertake surface-disturbing lease actions.

The BLM cannot reasonably determine at the leasing stage whether a nominated parcel will be leased, or if leased, whether the lease would be explored or developed or at what intensity development may occur.

The uncertainty that exists at the time the BLM offers a lease for sale includes factors that will affect potential impacts, such as: well density; geological conditions; development type (vertical, directional, horizontal); hydrocarbon characteristics; equipment to be used during construction, drilling, production, and abandonment operations; and potential regulatory changes over the life of the 10-year primary lease term.

This chapter defines the scope of analysis contained in this EA, describes the existing conditions relevant to the issues presented in Table 1 in Section 1.4, and discloses the potential impacts of the Proposed Action and the No Action alternatives.

General Setting

This parcel is approximately 40 acres of non-Federal surface estate overlying 50 percent Federal minerals estate located in Climax Township, Kalamazoo County, Michigan, about 15 miles east of the city of Kalamazoo, Michigan. The surface of the approximately 40-acre parcel is occupied by cultivated crops (approximately 31 acres), woody wetlands (approximately 7 acres), and one acre of development. Within the four-mile assessment area around the parcel the predominate land covers are cultivated crops, woody wetlands, and deciduous forest. A detailed list of the land cover in the four-mile assessment area can be found in Table 3.11. There is no known additional Federal surface estate within the four-mile assessment area. Other than the subject parcel, there is currently no known Federal mineral estate within the four-mile assessment area. The nearest Federal minerals are found slightly greater than four miles either north or south of the parcel.

Baseline Conditions

Past, present, and reasonably foreseeable future actions independent of the Proposed Action are considered the baseline conditions of the No Action Alternative and Affected Environment of the Proposed Action. The baseline conditions include predictable future trends in the area (i.e., if the affected environment has a history of oil and gas development on private land developing private mineral estate and it is reasonable to foresee continued development in the future).

Environmental Consequences of No Action Alternative for All Issues

Under the No Action Alternative, the proposed parcel would not be leased. There would be no subsequent impacts from oil and/or gas construction, drilling, and production activities, or downstream use of any oil and gas produced. The No Action Alternative would not affect the

continuation of the current land and resource uses in the proposed lease area. Oil and gas exploration and development activities may continue in surrounding areas that are currently leased.

The BLM assumes that the No Action Alternative (no lease option) may result in less oil and gas production than under the Proposed Action Alternative. This reduction would diminish Federal and State royalty income and increase the potential for Federal minerals to be drained by wells on adjacent private or State lands. However, oil and gas production and consumption are driven by a variety of complex interacting factors including energy costs, energy efficiency, availability of other energy sources, economics, demographics, geopolitical circumstances, and weather; therefore, it is uncertain whether and to what extent the No Action Alternative may affect overall domestic oil and gas production.

Environmental Consequences of Leasing and Potential Development

If the BLM receives an application for an exploration or development action, it will prepare additional NEPA analysis. At that time, the BLM may apply additional impact minimization measures as COAs to moderate identified adverse effects beyond the protections provided by the lease stipulations (see Appendix D).

The BLM's analysis at the leasing stage is limited to those effects that are reasonably foreseeable at this time. The BLM cannot meaningfully determine at the leasing stage whether, when, and in what manner and intensity a lease would be explored or developed. The uncertainty at the lease sale stage includes crucial factors that will affect potential impacts, such as well density, geological conditions, development type (vertical, directional, horizontal), hydrocarbon characteristics, equipment to be used during construction, drilling, production, and abandonment operations, and potential regulatory changes over the life of the lease. Therefore, much of the discussion of potential environmental effects presented in the following resource or use-specific subsections is necessarily confined to qualitative rather than quantitative characterization.

3.1. Issue 1: How would ambient air quality in the analysis area be affected by air pollutant emissions generated from potential development of leases?

This section describes the present baseline and reasonably foreseeable trends in air quality that could be impacted by the Proposed Action and provides further discussion of the causal relationship between the Proposed Action and impacts on the affected environment if the BLM were to authorize oil and gas exploration and development operations on the subject lease parcels in the future.

3.1.1. Affected Environment

Air quality and climate are components of air resources which may be affected by BLM applications, activities, and resource management. Therefore, the BLM must consider and analyze the potential effects of BLM-authorized activities on air resources as part of the planning and decision-making process.

Congress designed the Clean Air Act (CAA) to protect public health and welfare from air pollution. Congress established the law's basic structure in the CAA Amendments of 1970, and made major revisions in 1977, 1990, and 2022. The Act requires the Environmental Protection

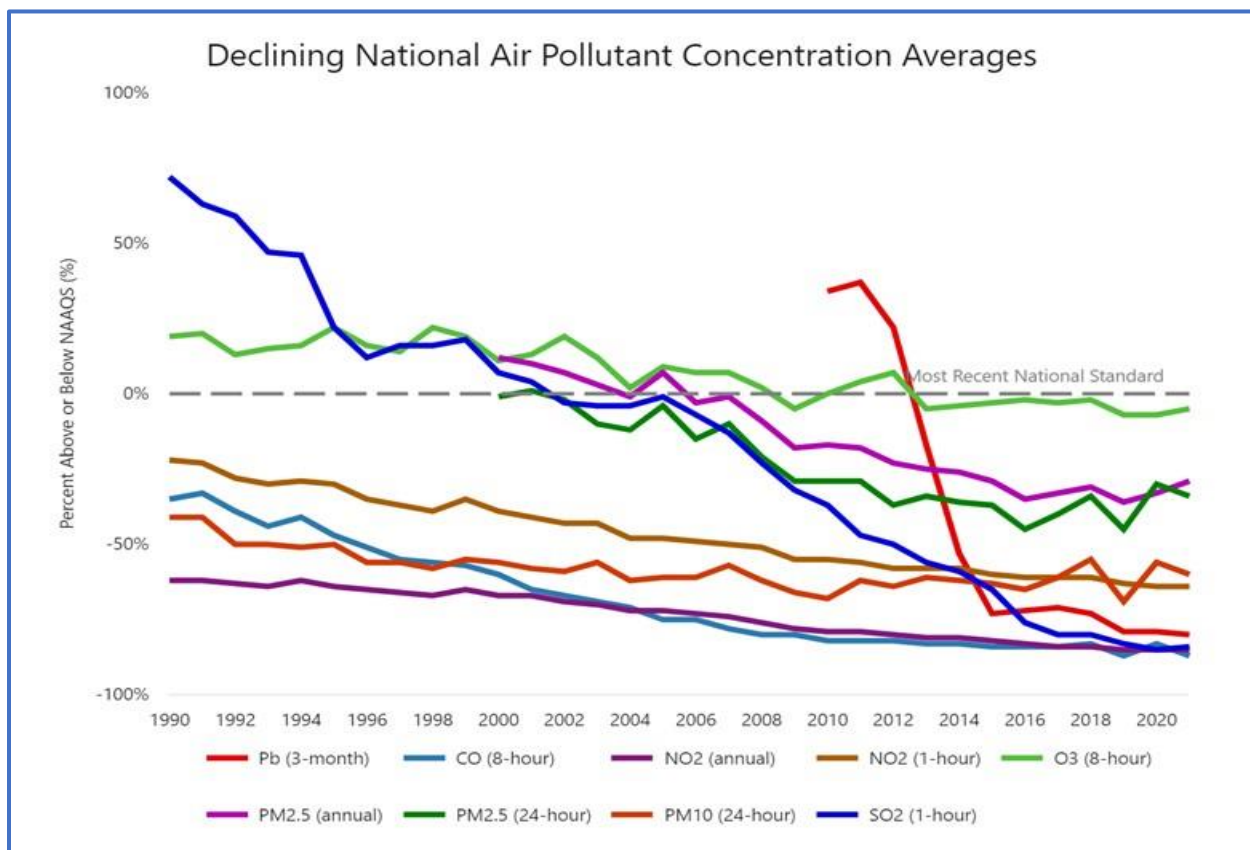
Agency (EPA) to establish and revise national ambient air quality standards (NAAQS). There are currently six criteria pollutants subject to a NAAQS: sulfur dioxide (SO₂), carbon monoxide (CO), coarse and fine particulate matter (PM₁₀ and PM_{2.5}), nitrogen dioxide (NO₂), ozone (O₃), and lead (Pb). The primary standards serve to protect public health, including the health of sensitive subpopulations, with an adequate margin of safety. Secondary standards serve to protect the public welfare from adverse effects on soil, water, crops, buildings, and other matters. Ensuring that all areas within the U.S. meet the NAAQS is a joint responsibility of states and EPA. In this partnership, states are responsible for developing enforceable state implementation plans to reduce ambient levels of air pollution to meet and maintain air quality that meets the NAAQS (EPA, 2015). The EGLE, Air Quality Division (AQD) is the delegated authority for protecting air quality in Michigan. The current NAAQS are provided in Table 3-1; AQD has not established any additional ambient air quality standards for Michigan (EPA, 2022a).

Table 3-1. National Ambient Air Quality Standards (as of November 23, 2022)

Criteria Pollutant	Primary Standards	Primary Standards	Secondary Standards
	Level	Averaging Time	Level Averaging Time
CO	9 ppm	8 hours	None
CO	35 ppm	1 hour	None
Pb	0.15 µg/m ³	Rolling 3-Month Average	Same as Primary
NO ₂	0.053 ppm	Annual (Arithmetic Average)	Same as Primary
NO ₂	100 ppb	1 hour	None
PM ₁₀	150 µg/m ³	24 hours	Same as Primary
PM _{2.5}	12.0 µg/m ³	Annual (Arithmetic Average)	15.0 µg/m ³ Annual (Arithmetic Average)
PM _{2.5}	35 µg/m ³	24 hours	Same as Primary
O ₃	0.070 ppm	8 hours	Same as Primary
SO ₂	75 ppb	1 hour	0.5 ppm 3 hours

Kalamazoo County, MI has one ambient air quality monitor that measures 8-hour O₃ levels (EPA, 2022a). According to EPA's Air Trends report, since 1990, nationwide air quality has improved significantly for the six criteria air pollutants. Figure 1 shows the reductions in air ambient air pollutant concentration compared each NAAQS from 1990 to 2020. National levels are averages across all monitors with complete data for the period. The air quality data for PM_{2.5} begin in 2000 and Pb 3-month begin in 2010.

Figure 1. Ambient Air Pollution Levels 1990-2020 (EPA, 2020a)



Nationally, ambient air pollution concentrations have dropped significantly since 1990.

- CO 8-Hour – 79% reduction;
- Pb 3-Month Average – 85% reduction;
- NO₂ Annual – 61% reduction;
- NO₂ 1-Hour – 54% reduction;
- O₃ 8-Hour – 21% reduction;
- PM₁₀ 24-Hour – 32% reduction;
- PM_{2.5} Annual – 37% reduction;
- PM_{2.5} 24-Hour – 33% reduction; and
- SO₂ 1-Hour – 91% reduction (EPA, 2020a).

Areas where ambient air quality concentrations do not meet the NAAQS are designated as nonattainment areas. Areas where air quality meets the standards are called attainment areas. To preserve clean air in attainment areas, the 1977 Act added the Prevention of Significant Deterioration (PSD) program. The PSD program established an area classification scheme for attainment areas (EPA, 2015). Class I areas receive the highest degree of protection, with the smallest amount of additional air pollution allowed. Class II areas allow a moderate increase in certain air pollutants. No areas of the U.S. have been designated Class III, which would allow more air quality degradation (NPS, 1991). Kalamazoo County is a maintenance attainment area

for O₃ and an attainment area for all other criteria pollutants. It has a PSD Class II designation (EPA, 2022a; NPS, 2022a). Regulated air pollutant emissions from the project are not anticipated to exceed the threshold for a PSD review for ambient air quality impacts.

General Conformity regulations established by the EPA ensure that actions taken by federal agencies do not interfere with a state's plans to attain and maintain national standards for air quality. Established under CAA Section 176(c)(4), the General Conformity rule helps states and tribes improve air quality in those areas that do not meet the NAAQS. Under the General Conformity rule, federal agencies must work with state, tribal, and local governments in nonattainment or maintenance areas to ensure that federal actions conform to the air quality plans established in the applicable state or tribal implementation plan. Although the proposed area is a maintenance area for O₃, a general conformity analysis is not required because total direct and indirect emissions of VOC and NO₂ are below the de minimis threshold for general conformity applicability in Title 40 of the Code of Federal Regulations §93.153(b)(2) (EPA, 2022a).

EPA and AQD also regulate hazardous air pollutants (HAP) and AQD additionally regulates toxic air contaminants (TAC). While HAP do not impact ambient air quality, these air pollutants are known to cause cancer and other serious health impacts. EPA has published standards for HAP emissions from specific categories of equipment, such as stationary reciprocating internal combustion engines used for site emergency electrical power generation.

The AQD administers, regulates, and enforces state air pollutant regulations via issuance and enforcement of permits. AQD has been delegated authority by EPA to enforce its ambient air quality standards and federal regulations for HAP and other air pollutants.

O₃ is formed from a photochemical reaction between oxygen, volatile organic compounds (VOC), and NO₂. VOC are compounds containing carbon with a low vapor pressure. Since VOC emissions are regulated to control O₃ formation, VOC emissions are included in this analysis instead of O₃.

Local Climate and Global Climate

Local Climate

In the Köppen-Geiger climate classification system, Kalamazoo County is classified as Dfa: humid, continental, typified by hot summers and cold snowy winters (Kottek, 2017). This area experiences an average annual rainfall of 33 inches, with precipitation regularly occurring each month of the year. The highest average precipitation typically occurs in May. The summer average temperature is 70.7°F, and the maximum recorded temperature was 109°F. The winter average temperature is 27.6°F, and the minimum recorded temperature was -22°F (NWS, 2022). From 1972 to 2022, the average wind speed 8.8 miles per hour, with winds primarily from the south (Iowa State University [ISU], 2022).

Global Climate

Greenhouse gases (GHGs) are gases in the atmosphere that absorb infrared electromagnetic radiation, contributing to the greenhouse effect. Increasing the concentration of GHGs in the atmosphere amplifies the greenhouse effect, changing our climate, including changes in

temperature, precipitation, and other variables, as described in the *BLM Specialist Report on Annual Greenhouse Gas Emissions and Climate Trends* (BLM, 2022a) (hereinafter referred to as the *Annual GHG Report*). The *Annual GHG Report* is incorporated by reference as an integral part of this analysis.

GHGs including carbon dioxide (CO₂) and water vapor are emitted into the atmosphere through natural processes and human activities. Other GHGs (e.g., fluorinated gases) are created and emitted solely through human activities. The primary GHGs that enter the atmosphere due to anthropogenic activities include CO₂, methane (CH₄), nitrous oxide (N₂O), and fluorinated gases such as hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF₆), with CO₂ being the most abundant anthropogenic GHG emitted (BLM, 2022a).

The impacts from GHGs on global warming vary depending on how long the compounds lasts in the atmosphere and its ability to absorb infrared radiation. To measure and compare climate impacts between various GHGs, a factor was developed for each GHG to account for these effects; this factor is known as the Global Warming Potential (GWP). Emissions of GHGs are converted into an equivalent amount of CO₂ (CO₂e) by multiplying the GHG by its GWP. The larger the GWP, the more radiative adsorption of the GHG relative to an equal amount of CO₂ (BLM, 2022a).

The choice of emission metric and time horizon depends on the type of application and policy context. The 100-year GWP was adopted by the United Nations Framework Convention on Climate Change and its Kyoto Protocol. In addition, the EPA uses the 100-year time horizon in its *Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990–2020* (EPA, 2020b), GHG Reporting Rule requirements under 40 CFR Part 98 Subpart A, and in its science communications, consistent with the Intergovernmental Panel on Climate Change (IPCC) Climate Change Synthesis Report (IPCC, 2014). In this EA, BLM uses the 100-year GWP time horizon in its GHG emission calculations, as provided by the EPA (EPA, 2022b). The GWP and GHG used in this report are provided in Table 3-2.

Table 3-2. GHG Pollutant vs. CO₂

GHG	CO ₂ Equivalent Emissions
CO ₂	1
CH ₄	25
N ₂ O	298

The IPCC concluded that “since systematic scientific assessments began in the 1970s, the influence of human activity on the warming of the climate system has evolved from theory to established fact (IPCC, 2021).” The annual average surface temperatures for the contiguous United States have increased 1.0°C (1.8°F) from 1900 to 2019. Annual average surface temperatures are expected to increase by about 1.4°C (2.5°F) regardless of future GHG emissions. Models of future GHG emissions demonstrate an increase the global average surface temperature between 1.6°C (3.0°F) to 6.6°C (12°F), depending on a low or high worldwide GHG emissions scenario. The conterminous U.S. has experienced varying rates of climate change, as the length of frost-free seasons have increased since the early 1900s, the frequency of cold waves has decreased since the early 1900s, and the frequency of heat waves has increased since the mid-1960s (BLM, 2022a).

Because GHGs circulate freely throughout Earth's atmosphere, the region of influence for GHGs is the entire globe. The largest component of global anthropogenic GHG emissions is CO₂. Global anthropogenic GHG emissions reached 700 gigatons (700,000,000,000 metric tons) in 2019, with CO₂ emissions from fossil-fuel combustion comprising 64% of that total, and the remainder resulting from land-use change (IPCC, 2021).

Potential impacts to air quality due to climate change vary. Although potential GHG emissions at the project level can be quantified, currently methodologies do not permit an assessment between project-scale GHG emissions and specific effects on climate change, as effects on climate change are influenced by all global GHG emissions. For Michigan, the EPA has identified the following continued changes due to an increasingly warmer climate (EPA, 2016):

- Increase in the frequency of heavy rainstorms, which increases the risk of flooding and sewer overflows into water bodies;
- Decreasing the ice cover on the Great Lakes, with ice forming later and melting sooner;
- Increase the number of algal blooms in the Great Lakes, which harm fish and decrease water quality;
- Change the migration patterns of animals, leading to food source disruption;
- Changes to the composition of forests, with decreases in paper birch, quaking aspen, balsam fir and black spruce, and increase in white oak, hickory, and pine trees;
- Increase in water temperatures, which negatively impacts fish habitats;
- Change to crop yields with increases of wheat but decreases corn and soybean yield;
- Higher temperatures and more frequent and severe heat waves, which can threaten human health by causing heat stroke and dehydration; and
- Decreases in air quality due to the increase in formation of ground-level O₃, a pollutant that causes lung and heart problems and harms plants.

3.1.2. Environmental Impacts

The proposed leasing action could lead to emissions of the air pollutants carbon monoxide (CO), nitrogen dioxide (NO₂), coarse and fine particulate matter (PM₁₀ and PM_{2.5}), sulfur dioxide (SO₂), volatile organic compounds (VOC). O₃ is not directly emitted by oil and natural gas production; rather, it is formed from a photochemical atmospheric reaction between oxygen, VOC, and NO₂. VOC emissions are regulated to control O₃ formation, so VOC emissions are included in this analysis instead of O₃.

These emissions would be emitted from the leased parcel if developed and from the consumption of any fluid minerals that may be produced. However, the BLM cannot reasonably determine at the leasing stage whether, when, and in what manner a lease would be explored or developed. The uncertainty that exists at the time the BLM offers a lease for sale includes crucial factors that would affect actual emissions and associated impacts, including but not limited to the future feasibility of developing the lease, well density, geological conditions, development type (i.e., vertical, directional, or horizontal), hydrocarbon characteristics, specific equipment used during construction, drilling, production, abandonment operations, production and transportation, and potential regulatory changes over the 30-year direct lease term.

For the purposes of this analysis, the BLM has developed a RFDS that includes the potential effects of the proposed leasing action on air quality and climate change. This analysis estimates potential air pollution from projected oil and natural gas development on the parcel proposed for leasing using available information from existing oil and natural gas development within the State of Michigan. The RFDS projection is that up to two new well pads could be located on the subject parcel, as Michigan restricts drilling to 40 acres, with well pads separated by at least 330 feet from drilling boundaries (MDEQ, 2018). Based on the RFDS, each well pad could accommodate either a single vertical well or up to three horizontal wells. Surface disturbance is estimated to be 3.4 acres for each vertical well and 4.32 acres for each horizontal well. Vertical well depth to the Trenton formation is estimated to be 3,900 feet, with a 2,000 foot horizontal extension for horizontal wells. However, though used in rare circumstances, advances in hydrofracturing techniques could allow for a horizontal extension up to four miles to drill a horizontal well that penetrates Federal minerals and this distance was used as the buffer for the assessment area.

The National Ambient Air Quality Standards (NAAQS) are established by the U.S. Environmental Protection Agency (EPA) as nationwide standards for air quality; state ambient air quality standards Michigan are equivalent to the NAAQS. The proposed action will be located in Kalamazoo County, Michigan, which meets all NAAQS for CO, NO₂, O₃, PM₁₀ and PM_{2.5}, and SO₂ (EPA, 2022c).

3.1.2.1. *Impacts of the Alternative A – No Action Alternative*

Under the No Action Alternative, BLM would not lease the proposed parcel. No new attendant infrastructure associated with oil and gas development would be built under the No Action Alternative. Potential impacts to air quality would not occur because the lease would not be developed, and no new emissions of pollutants would occur.

3.1.2.2. *Impacts of the Alternative B – Proposed Action*

While the leasing action does not directly result in development that will generate air pollution, emissions from potential future development of the leased parcels are reasonably foreseeable and can be estimated for the purposes of this lease sale. There are four general phases of post-lease development that would generate air pollution: 1) well development (i.e., well site construction, well drilling, and well completion), 2) well production operations (i.e., extraction, separation, gathering), 3) mid-stream (i.e., refining, processing, storage, and transport/distribution), and 4) end-use (i.e., combustion or other uses) of the fuels produced. While well development and production operation emissions occur on-lease and the BLM has program authority over these activities, mid-stream and end-use emissions typically do not occur within the parameters of the lease and BLM has no program authority for these emissions.

Emissions inventories at the leasing stage are imprecise due to uncertainties including the type of mineral development (e.g., oil, natural gas, or both), scale, and duration of potential development, types of equipment (e.g., drill rig engine rating, horsepower, fuel type), and the mitigation measures that a future operator may propose in their development plan. To estimate reasonably foreseeable on-lease emissions at the leasing stage, the BLM uses estimated well numbers based on State data for past lease development combined with per-well drilling, development, and operating emissions data from representative wells in the area. The amount of

oil or natural gas that may be produced if the offered parcels are developed is unknown. For purposes of estimating production and end-use emissions, potential wells are assumed to produce oil and natural gas in similar amounts as existing nearby wells.

Emissions vary annually over the production life of a well due to declining production over time. Table 3-3 provides maximum year and average year emissions for air pollutants, including hazardous air pollutants (HAP).

Table 3-3. Estimated Direct and Indirect Maximum Year and Average Year Air Pollutant Emissions (tons)

Activity	PM ₁₀	PM _{2.5}	VOC	NO ₂	CO	SO ₂	HAPs
Max Year	2.1	1.3	5.5	10.4	4.7	0.036	1.032
Average Year	1.2	0.8	4.4	2.2	2.3	0.011	0.918

Source: BLM Lease Sale Emissions Tool

EPA established the Prevention of Significant Deterioration (PSD) program to ensure that new or modified major sources of air pollution do not cause or contribute to a NAAQS violation, allowing Kalamazoo County to retain their NAAQS attainment designations. Direct emissions of air pollution from the proposed action are well below the 250 tpy applicability thresholds for PSD for regulated air pollutants, as provided in Title 40 of the CFR, Part 52.21(b)(1)(i)(b); indirect air pollutant and GHG emissions are not used to determine PSD applicability. Since air pollutant emissions from the proposed action are below the PSD major source applicability thresholds, the proposed action would not cause Kalamazoo County to be reclassified as a non-attainment area for any of the NAAQS.

The EGLE is the delegated authority in Michigan to implement and enforce this standard and regulates oil and natural gas production facilities and associated operations (e.g., storage tanks, engines) via a permitting program.

EGLE used NO₂, SO₂, VOC, and ammonia emissions for determining visibility impacts (regional haze) to nearby Class I areas for its determination of sources subject to the regional haze program. NO₂, SO₂, and VOC emissions from the proposed action are less than 100 tons and significantly below the threshold of 250 tons per year of NO₂ or SO₂ emissions for sources determined to be eligible for further review. Additionally, oil and natural gas production are not included by EGLE or EPA as an applicable source in the Michigan regional haze program (Government Printing Office [GPO], 2012).

3.1.3 Cumulative Impacts Analysis

Although the estimates provided above attempt to quantify total air pollutant emissions derived from well development through end use combustion, there exists significant uncertainty due to a variety of unknown factors including actual production, product utilization, geologic formations, and use of available BMPs and other technologies. To conduct a cumulative impacts analysis, BLM reviewed direct air pollutant emissions from the operation of federal mineral oil and natural gas wells within the state of Michigan, the Northeastern States region, and the nation. For this analysis, BLM used national, per-well average air pollutant emissions estimates, which may underestimate or overestimate actual emissions within the state of Michigan; however, BLM is

overestimating cumulative emissions by assuming as the RFDS that all Federal Mineral Ownership (FMO) leases will be placed into maximum production. The maximum direct emissions from the Proposed Action are presented in Table 3-4.

Table 3-4. Estimated Direct Maximum Year Air Pollutant Emissions (tons) from Proposed Action

Activity	PM ₁₀	PM _{2.5}	VOC	NO ₂	CO	SO ₂	HAPs
Proposed Action	1.23	0.86	4.84	1.84	2.35	0.01	1.01

Source: BLM Single Well Emissions Tool

Indirect emissions were not included in this cumulative analysis, as additional oil or natural gas will be obtained from alternate sources, (e.g., wells on private land, existing FMO leases), if the proposed action is not implemented. This will not result in any change at the state, regional, or national level in indirect emissions from the combustion of oil or natural gas. The U.S. Energy Information Administration (EIA) projections for the domestic production of petroleum and other liquids are included in the *Annual GHG Report* (BLM, 2022a). This report presents the estimated emissions of greenhouse gases attributable to development and consumption of fossil fuels produced on lands and mineral estate managed by the BLM. The *Annual GHG Report* is incorporated by reference as an integral part of this analysis.

Michigan

The cumulative impacts analysis area is defined as the FMO estate in Michigan with active leases for oil and natural gas development. As of 2021, there were 139 effective FMO leases, with 171 wells on 59 FMO leases in Michigan that were producing oil or natural gas (42.4 percent of effective FMO leases are producing with an average of 2.9 wells per lease) (BLM, 2022b). Cumulative direct air pollutant emissions are estimated in Table 3-5 from the Proposed Action and an RFDS that all existing FMO leases in Michigan are developed with the current average number of producing wells.

Table 3-5. Estimated Direct Air Pollutant Emissions (tons) for RFDS FMO in Michigan

Activity	PM ₁₀	PM _{2.5}	VOC	NO ₂	CO	SO ₂
Michigan FMO	5.6	5.3	527.9	294.0	407.3	2.0

Source: MI2 Air Quality Cumulative Emissions Analysis

The total air pollutant emissions from the Proposed Action would represent a maximum increase of 0.9 percent above the maximum cumulative direct annual air pollutant emissions, if multiple oil and/or natural gas wells were developed on all effective Michigan FMO leases. The emissions from the Proposed Action are minute compared to the maximum cumulative air pollutant emissions for all FMO leases in Michigan.

Regional - Northeastern States District Office (NSDO)

The cumulative impacts analysis area is defined as the FMO estate within lands managed by the BLM NSDO, with active leases for oil and natural gas development. The BLM NSDO manages FMO within the following states: Connecticut, Delaware, Illinois, Indiana, Iowa, Maine,

Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, West Virginia, and Wisconsin.

As of 2021, there were 738 effective FMO leases, with 1,279 wells on 518 FMO leases in the NSDO that were producing oil or natural gas (70.2 percent of effective FMO leases are producing with an average of 2.5 wells per lease) (BLM, 2022b). Cumulative direct air pollutant emissions are estimated in Table 3-6 from the Proposed Action and an RFDS that all existing FMO leases within the NSDO are developed with the current average number of producing wells.

Table 3-6. Estimated Direct Air Pollutant Emissions (tons) for RFDS FMO in NSDO

Activity	PM ₁₀	PM _{2.5}	VOC	NO ₂	CO	SO ₂
NSDO FMO	14.8	14.5	1,870.5	666.0	866.5	46.6

Source: MI2 Air Quality Cumulative Emissions Analysis

The total air pollutant emissions from the Proposed Action would represent a maximum increase of 0.3 percent above the maximum cumulative direct annual air pollutant emissions if multiple oil and/or natural gas wells were developed on all effective FMO leases within the NSDO. The emissions from the Proposed Action are minute compared to the maximum cumulative air pollutant emissions for all FMO leases in the NSDO.

National

For 2021, BLM managed 35,871 effective FMO leases nationwide, with 94,726 wells on 23,803 FMO leases that were producing oil or natural gas (66.4% of effective FMO leases are producing with an average of 4.0 wells per lease) (BLM, 2022b). Cumulative direct air pollutant emissions are estimated in Table 3-7 from the Proposed Action and an RFDS that all existing FMO leases nationwide are developed with the current average number of producing.

Table 3-7. Estimated Direct Air Pollutant Emissions (tons) for RFDS FMO in the U.S.

Activity	PM ₁₀	PM _{2.5}	VOC	NO ₂	CO	SO ₂
National FMO	1,857	1,714	360,739	89,365	91,506	9,279

Source: MI2 Air Quality Cumulative Emissions Analysis

The total air pollutant emissions from the Proposed Action would represent a maximum increase of 0.002 percent above the maximum cumulative direct annual air pollutant emissions, if multiple oil and/or natural gas wells were developed on all effective FMO leases within the U.S. The emissions from the Proposed Action are minute compared to the maximum cumulative air pollutant emissions for all FMO leases in the U.S.

3.2. Issue 2: How would future potential development of leases contribute to greenhouse gas (GHG) emissions and climate change?

Future development of the lease parcels under consideration could lead to emissions of carbon dioxide (CO₂), methane (CH₄), and nitrous oxide (N₂O), the three most common greenhouse gases associated with oil and natural gas development. These GHG emissions would be emitted from leased parcels if developed, and from the consumption of any fluid minerals that may be

produced. However, the BLM cannot reasonably determine at the leasing stage whether, when, and in what manner a lease would be explored or developed. The uncertainty that exists at the time the BLM offers a lease for sale includes crucial factors that would affect actual GHG emissions and associated impacts, including but not limited to the future feasibility of developing the lease, well density, geological conditions, development type (i.e., vertical, directional, or horizontal), hydrocarbon characteristics, specific equipment used during construction, drilling, production, abandonment operations, production and transportation, and potential regulatory changes over the 10-year primary lease term. Actual development on a lease may vary from what is analyzed in this EA and may be evaluated through site-specific NEPA analysis when an operator submits an APD or plan of development to the BLM.

For the purposes of this analysis, the BLM has evaluated the potential effects of the proposed leasing action on climate change by estimating and analyzing potential GHG emissions from projected oil and natural gas development on the parcels proposed for leasing using estimates based on past oil and natural gas development and available information from existing development within the State.

Further discussion of climate change science and predicted impacts, as well as the reasonably foreseeable and cumulative GHG emissions associated with BLM's oil and gas leasing actions, are included in the *BLM Specialist Report on Annual Greenhouse Gas Emissions and Climate Trends* (BLM, 2022a) (hereinafter referred to as the *Annual GHG Report*). This report presents the estimated emissions of greenhouse gases attributable to development and consumption of fossil fuels produced on lands and mineral estate managed by the BLM. The Annual GHG Report is incorporated by reference as an integral part of this analysis and is available at <https://www.blm.gov/content/ghg/2022>

3.2.1. Affected Environment

Climate change is a global process that is affected by the sum of GHGs in the Earth's atmosphere. The incremental contribution to global GHGs from a single proposed land management action cannot be accurately translated into its potential effect on global climate change or any localized effects in the area specific to the action. Currently, global climate models are unable to forecast local or regional effects on resources because of specific emissions. However, there are general projections regarding potential impacts on natural resources and plant and animal species that may be attributed to climate change resulting from the accumulation of GHG emissions over time. GHGs influence the global climate by increasing the amount of solar energy retained by land, water bodies, and the atmosphere. GHGs can have long atmospheric lifetimes, which allows them to become well mixed and uniformly distributed over the entirety of the Earth's surface no matter their point of origin. Therefore, potential emissions resulting from the proposed action can be compared to state, national and global GHG emission totals to provide context of their significance and potential contribution to climate change impacts.

Table 3-8 shows the total estimated GHG emissions from fossil fuels at the global, national, and state scales over the last five years. Emissions are shown in megatonnes (Mt) per year of carbon dioxide equivalent (CO₂e). Chapter 3 of the *Annual GHG Report* contains additional information on GHGs and an explanation of CO₂e. State and national energy-related CO₂ emissions include emissions from fossil fuel use across all sectors (i.e., residential, commercial, industrial,

transportation, and electricity generation) and are released at the location where the fossil fuels are consumed.

Additional information on current state, national, and global GHG emissions as well as the methodology and parameters for estimating emissions from BLM fossil fuel authorizations and cumulative GHG emissions is included in the *Annual GHG Report* (see Chapters 4, 5, and 6).

Table 3-8. Global and U.S. GHG Emissions 2015-2020 (Mt CO₂e/year)

Scale	2016	2017	2018	2019	2020
Global	36,465.6	36,935.6	37,716.2	37,911.4	35,962.9
U.S.	5,077.0	5,005.5	5,159.3	5,036.0	4,535.3
Michigan	190.4	187.9	195.7	190.7	N/A

Source: Annual GHG Report, Chap. 6, Table 6-1 (Global and U.S.) and Table 6-3 (Michigan).

Mt (Megaton) = 1 million metric tons

N/A = Not Available

The continued increase of anthropogenic GHG emissions over the past 60 years has contributed to global climate change impacts. A discussion of past, current, and projected future climate change impacts is described in Chapters 8 and 9 of the *Annual GHG Report*. These chapters describe currently observed climate impacts globally, nationally, and in each State, and present a range of projected impact scenarios depending on future GHG emission levels. These chapters are incorporated by reference in this analysis.

3.2.2. Environmental Impacts

3.2.2.1. *Impacts of the Proposed Action*

While the leasing action does not directly result in development that will generate GHG emissions, emissions from potential future development of the leased parcels are reasonably foreseeable and can be estimated for the purposes of this lease sale. There are four general phases of post-lease development that would generate GHG emissions: 1) well development (i.e., well site construction, well drilling, and well completion), 2) well production operations (i.e., extraction, separation, gathering), 3) mid-stream (i.e., refining, processing, storage, and transport/distribution), and 4) end-use (i.e., combustion or other uses) of the fuels produced. While well development and production operation emissions occur on-lease and the BLM has program authority over these activities, mid-stream and end-use emissions typically occur off-lease where the BLM has no program authority.

Emissions inventories at the leasing stage are imprecise due to uncertainties including the type of mineral development (i.e., oil, natural gas, or both), scale, and duration of potential development, types of equipment (e.g., drill rig engine tier rating, horsepower, fuel type), and the mitigation measures that a future operator may propose in their development plan. To estimate reasonably foreseeable on-lease emissions at the leasing stage, the BLM uses estimated well numbers based on State data for past lease development combined with per-well drilling, development, and operating emissions data from representative wells in the area. The amount of oil or gas that may

be produced if the offered parcels are developed is unknown. For purposes of estimating production and end-use emissions, potential wells are assumed to produce oil and gas in similar amounts as existing nearby wells. This parcel in Kalamazoo, Michigan, and the wells would primarily target the Trenton formation and Climax field for oil production. While the BLM has no authority to direct or regulate the end-use of the products, for this analysis, the BLM assumes all produced oil or natural gas will be combusted (such as for domestic heating or energy production). The BLM acknowledges that there may be additional sources of GHG emissions along the distribution, storage, and processing chains (commonly referred to as midstream operations) associated with production from the lease parcels. These sources may include emissions of methane (a more potent GHG than CO₂ in the short term) from pipeline and equipment leaks, storage, and maintenance activities. These sources of emissions are highly speculative at the leasing stage, therefore, the BLM has chosen to assume that mid-stream emissions associated with lease parcels for this analysis will be similar to the national level emissions identified by the Department of Energy's National Energy Technology Laboratory (NETL, 2009) (NETL, 2019).

The emission estimates calculated for this analysis were generated using the assumptions previously described above using the BLM Lease Sale Emissions Tool. Emissions are presented for each of the four phases of post-lease development described above.

- Well development emissions occur over a short period and may include emissions from heavy equipment and vehicle exhaust, drill rig engines, completion equipment, pipe venting, and well treatments such as hydraulic fracturing.
- Well production operations, mid-stream, and end-use emissions occur over the entire production life of a well, which is assumed to be 30 years for this analysis based on the productive life of a typical oil/gas field.
- Production emissions may result from storage tank breathing and flashing, truck loading, pump engines, heaters and dehydrators, pneumatic instruments or controls, flaring, fugitives, and vehicle exhaust.
- Mid-stream emissions occur from the transport, refining, processing, storage, transmission, and distribution of produced oil and natural gas. Mid-stream emissions are estimated by multiplying the estimated ultimate recovery (EUR) of produced oil and gas with emissions factors from NETL life cycle analysis of U.S. oil and natural gas. Additional information on emission factors can be found in the *Annual GHG Report* (Chapter 4, Table 4-7 and 4-9).
- For the purposes of this analysis, end-use emissions are calculated assuming all produced oil and gas is combusted for energy use. End-use emissions are estimated by multiplying the EUR of produced oil and gas with emissions factors for combustion established by the EPA (Tables C-1 and C-2 to Subpart C of 40 CFR § 98). Additional information on emission factors and EUR factors can be found in the *Annual GHG Report* (Chapter 4).

Table 3-9 lists the estimated direct (i.e., well development and production operations) and indirect (i.e., mid-stream and end-use) GHG emissions in metric tons (tonnes) for the subject leases over the average 30-year production life of the lease.

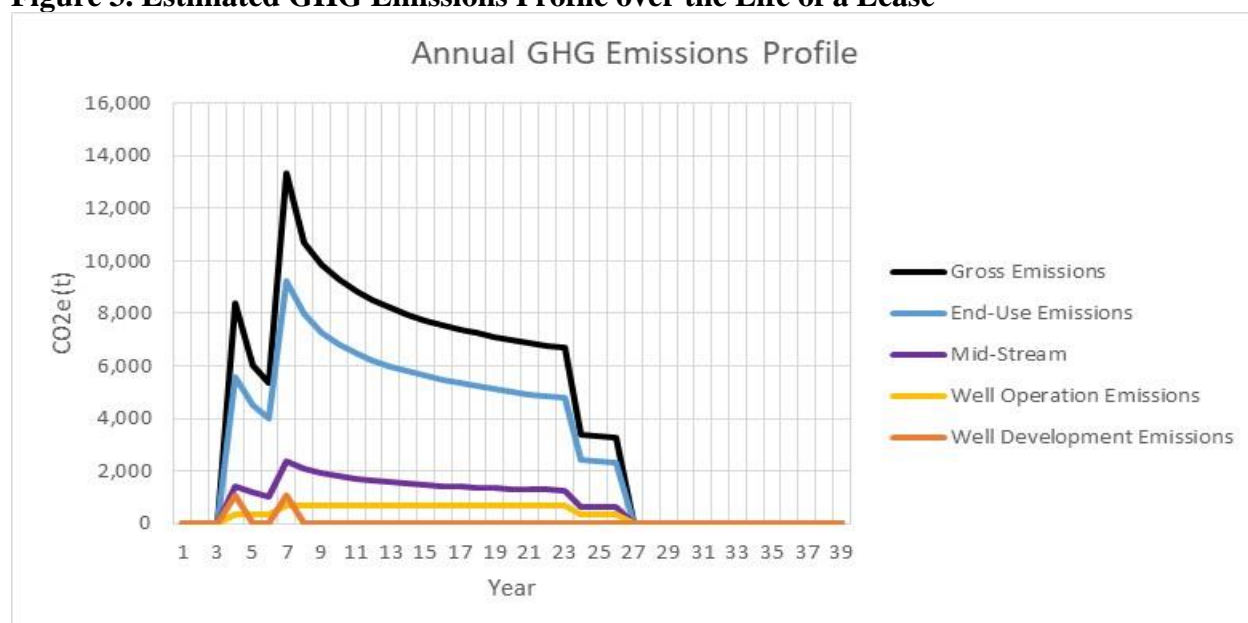
Table 3-9. Estimated Life of Lease Emissions from Well Development, Well Production Operations, Mid-stream, and End-use (tonnes)

Activity	CO ₂	CH ₄	N ₂ O	CO ₂ e (100-yr)	CO ₂ e (20-yr)
Well Development	2,085	1.78	0.016	2,143	2,237
Well Production Operations	12,367	23.06	0.084	13,077	14,292
Mid-Stream	22,401	329.81	0.310	32,314	49,695
End-Use	123,120	2.41	0.259	123,263	123,390
Total	159,973	357.07	0.668	170,796	189,613

Source: BLM Lease Sale Emissions Tool

GHG emissions vary annually over the production life of a well due to declining production rates over time. Figure 3 shows the estimated GHG emissions profile over the production life of a typical lease including well development, well production operations, mid-stream, end-use, and gross (i.e., total of well development, well production, mid-stream, and end-use) emissions.

Figure 3. Estimated GHG Emissions Profile over the Life of a Lease



Source: BLM Lease Sale Emissions Tool

To put the estimated GHG emissions for this lease sale in a relatable context, potential emissions that could result from development of the lease parcels for this sale can be compared to other common activities that generate GHG emissions and to emissions at the state and national level. The EPA GHG equivalency calculator (EPA, 2022d) can be used to express the potential average year GHG emissions on a scale relatable to everyday life. For instance, the projected average annual GHG emissions from potential development of the subject lease are equivalent to 1,600 gasoline-fueled passenger vehicles driven for one year, or the emissions that could be avoided by

operating 2 wind turbines as an alternative energy source or offset by the carbon sequestration of 8,840 acres of forest land.

Table 3-10 compares emission estimates over the 30-year life of the lease compared to the 30-year projected Federal emissions in the state and nation from existing wells, the development of approved APDs, and emissions related to reasonably foreseeable lease actions.

Table 3-10. Comparison of the Life of Lease Emissions to other Federal Oil and Natural Gas Emissions

Reference	Mt CO ₂ e (100-yr)	Life of Lease % of Reference
Lease Sale Emissions (Life of Lease)	0.171	100.000%
MI Reasonably Foreseeable Short-term Federal (O&G)¹	1.95	8.759%
MI EIA Projected Long-term Federal (O&G)²	3.08	5.551%
U.S. Short-term Federal (O&G)	4,614.81	0.004%
U.S. Long-term Federal (O&G)	13,560.24	0.001%

Source: U.S. and Federal emissions from BLM Lease Sale Emissions Tool and *Annual GHG Report* Tables 5-17 and 5-18.

¹ Short-term foreseeable is estimated Federal emissions from existing producing wells, approved APDs, and one year of leasing.

² Long-term foreseeable are estimated Federal emissions to meet EIA projected energy demand.

Compared to emissions from other existing and foreseeable short-term Federal oil and natural gas development, the life of lease emissions for the Proposed Action is 10.608% of Federal fossil fuel authorization emissions in the state and between 0.001% to 0.002% of Federal fossil fuel authorization emission in the nation (EPA, 2022d). If foreseeable “long-term” Federal oil and natural gas development and production remains a constant percentage of EIA projected energy demand, then the estimated emissions from the life of leases in the Proposed Action is between 0.001% and 0.004% of Federal emissions in the nation over the next 30 years. In summary, potential GHG emissions from the Proposed Action could result in GHG emissions of 0.171 MT CO₂e over the life of the lease.

The “social cost of carbon”, “social cost of nitrous oxide”, and “social cost of methane” – together, the “social cost of greenhouse gases” (SC-GHG) are estimates of the monetized damages associated with incremental increases in GHG emissions in a given year. Such analysis should not be construed to mean a cost determination is necessary to address potential impacts of GHGs associated with specific alternatives. These numbers were monetized; however, they do not constitute a complete cost-benefit analysis, nor do the SC-GHG numbers present a direct comparison with other impacts analyzed in this document SC-GHG is provided only as a useful measure of the benefits of GHG emissions reductions to inform agency decision-making. For Federal agencies, the best currently available estimates of the SC-GHG are the interim estimates

of the social cost of carbon dioxide (SC-CO₂), methane (SC-CH₄), and nitrous oxide (SC-N₂O) developed by the Interagency Working Group (IWG) on the SC-GHG. Select estimates are published in the Technical Support Document (IWG, 2021) and the complete set of annual estimates are available on the Office of Management and Budget’s website (OMB, 2023).

The SC-GHGs associated with estimated emissions from future potential development of the lease parcels are reported in Table 3-11. These estimates represent the present value (from the perspective of 2021) of future market and nonmarket costs associated with CO₂, CH₄, and N₂O emissions from potential well development and operations, and potential end-use, as described in Subsection 1.2.1. Estimates are calculated based on IWG estimates of social cost per metric ton of emissions for a given emissions year and BLM’s estimates of emissions in each year. They are rounded to the nearest \$1,000. The estimates assume development will start in 2026 and end-use emissions complete in 2048, based on experience with previous lease sales.

Table 3-11. SC-GHGs Associated with Future Potential Development

	Social Cost of GHGs (2022 \$)	Social Cost of GHGs (2022 \$)	Social Cost of GHGs (2022 \$)	Social Cost of GHGs (2022 \$)
	Average Value, 5% discount rate	Average Value, 3% discount rate	Average Value, 2.5% discount rate	95th Percentile Value, 3% discount rate
Development and Operations	\$183,000	\$697,000	\$1,054,000	\$2,106,000
Mid-Stream and End-Use	\$1,891,000	\$7,128,000	\$10,767,000	\$21,513,000
Total	\$2,074,000	\$7,825,000	\$11,821,000	\$23,619,000

As detailed in the *Annual GHG Report*, which the BLM has incorporated by reference, the BLM also looked at other tools to inform its analysis, including the MAGICC model (see Section 7.0 of the *Annual GHG Report*). This model run suggests that “30-plus years of projected federal emissions would raise average global surface temperatures by approximately 0.0158 °C., or 1% of the lower carbon budget temperature target.” As this is an assessment of what BLM has projected could come from the entire Federal fossil fuel program, including the projected emissions from the proposed action, over the next 30 years, the reasonably foreseeable lease sale emissions contemplated in this EA are not expected to substantially affect the rate of change in climate effects, bring forth impacts that are not already identified in existing literature, or cause a change in the magnitude of impacts from climate change at the state, national, or global scales.

3.2.2.2. *Impacts of the No Action Alternative*

Under the No Action Alternative, the BLM would not offer any of the nominated parcels in this lease sale. However, in the absence of a Land Use Plan Amendment closing the lands to leasing, they could be considered for inclusion in future lease sales. Although no new GHG emissions

associated with new Federal oil and gas development for the subject leases would occur under the No Action Alternative in the foreseeable future, the cumulative demand for energy is not expected to differ regardless of BLM decision-making (EIA, 2021). The BLM has no information regarding what energy source could fill the energy demand if development does not occur on the subject leases. Although the change in emissions compared to the Proposed Action could range from a 98.5% decrease if hydro-electricity is substituted to a 110.7% increase if coal is substituted, see Table 10-3 in Section 10.0 of the *Annual Report* (BLM, 2022a). Over the past decade the increasing mix of natural gas has contributed to lower emissions as it has replaced energy produced from coal. In 2022, high prices for natural gas and demand exceeding supply have resulted in some countries reactivating or delaying planned closures of coal fired power plants (Reuters, 2022). In the future, renewable energy is anticipated to become a larger part of the U.S. energy mix and reducing energy related carbon emissions. It has been estimated that with a 35% integration of wind and solar energy into the Western United States electric grid, there would be an additional 25-45% reduction in carbon emissions (BLM, 2022a). Based on this information there is potential for higher emissions over the short-term and reduced emissions over the long-term. The BLM cannot estimate the net effects across all energy markets to understand the mix of energy resources that will meet demand and therefore can't provide an estimate of SC-GHG for the No Action Alternative.

3.2.2.3. *Cumulative Emissions*

The analysis of GHGs presented in this EA includes estimated emissions for the lease parcels from the development, production, and end-use of the Federal fossil fuels. An assessment of GHG emissions from BLM's fossil fuel authorizations, including coal leasing and oil and natural gas leasing and development, is included in the *Annual GHG Report* (see Chapter 5). The *Annual GHG Report* includes estimates of reasonably foreseeable GHG emissions related to BLM lease sales anticipated during the calendar year, as well as the best estimate of emissions from ongoing production and development of parcels sold in previous lease sales. It provides an estimate of cumulative GHG emissions from the BLM fossil fuel leasing program based on actual production and statistical trends.

The *Annual GHG Report* provides an estimate of short-term and long-term GHG emissions from activities across the BLMs oil and natural gas program. The short-term methodology presented in the *Annual GHG Report* includes a trends analysis of (1) leased federal lands that are held-by-production, (2) approved APDs, and (3) leased lands from competitive lease sales occurring over the next annual reporting cycle (12 months), to provide a 30-year projection of potential emissions from Federal lease actions over the next 12 months. The long-term methodology uses oil and natural gas production forecasts from the EIA to estimate GHG emissions out to 2050 that could occur from past, present, and future development of Federal oil and natural gas. For both methodologies, the emissions are calculated using life-cycle-assessment (LCA) emissions and data factors. These analyses are the basis for projecting GHG emissions from lease parcels that are likely to go into production during the analysis period of the *Annual GHG Report* and represent both a hard look at GHG emissions from fossil fuel leasing and the best available estimate of reasonably foreseeable cumulative emissions related to any one lease sale or set of quarterly lease sales.

Table 3-12 shows the aggregate GHG emissions estimate that would occur from Federal leases, existing and foreseeable, between the years 2022 and 2050, using the methodology described

above. The 5-year lease averages include all types of oil and gas leases, including leases granted under the Mineral Leasing Act as well as other authorities, that have been issued over the last five years. As such the projections made from the 5-year averages represent the potential for all types of future oil and gas development activity, and although not at exact acreages, include emissions that would be associated with the subject leases. However, they may also over-estimate the potential emissions from the 12-month cycle of competitive oil and gas leasing activities if the projected lease sale or development activity does not actually occur or is less than estimated.

Table 3-12. Reasonably Foreseeable Projected Emissions from Federal Lease Development

State (BLM Administrative Unit)	GHG Emissions from Past, Present, and Foreseeable Federal Lease Development (Mt CO₂e per year) [†]
Alabama (ES)	9.34
Alaska	136.9
Arkansas (ES)	9.34
California	51.49
Colorado	243.1
Idaho	0.17
Illinois	0.31
Kansas (ES)	3.32
Kentucky (ES)	0.19
Louisiana (ES)	43.29
Michigan (ES)	1.95
Mississippi (ES)	2.89
Montana	58.82
Nebraska (WY)	0.21
Nevada	2.74
New Mexico	1,939.52
New York	0.01
North Dakota (MT)	379.63
Ohio (ES)	0.37
Oklahoma (NM)	20.43
Pennsylvania	0.46

State (BLM Administrative Unit)	GHG Emissions from Past, Present, and Foreseeable Federal Lease Development (Mt CO₂e per year) [†]
South Dakota (MT)	2.31
Texas (NM)	49.55
Utah	187.84
Virginia	0.15
West Virginia (ES)	0.45
Wyoming	1,487.65
Total	4,614.81

[†]Emissions obtained from the *Annual GHG Report*, Figure 5-1 (BLM, 2022a)

The most recent short-term energy outlook (STEO) published by the EIA (<https://www.eia.gov/outlooks/steo/>) (EIA, 2022a) predicts that the world's oil and gas supply and consumption will increase over the next 18-24 months. The latest STEO projections are adequate to use for the No Action discussion as the global forecast models used for the STEO are not dependent on whether the BLM issues onshore leases but are based on foreseeable short-term global supply and demand and include oil and gas development /operations on existing U.S. onshore leases. The most recent STEO includes the following projections for the next two years:

- Global liquid fuels consumption is projected to be 99.82 million barrels per day (b/d) in 2022 and increase to 100.98 million b/d in 2023.
- U.S. crude oil production averaged 11.2 million b/d in 2021. Production is expected to average 11.9 million b/d in 2022 and to rise to 12.3 million b/d in 2023.
- Natural gas production is expected to average 99.7 Bcf/d in 2023, 2% more than in 2022.
- U.S. LNG export capacity increases will contribute to LNG exports of 10.85 billion cubic feet/day (Bcf/d) in 2022, up from 9.76 Bcf/d in 2021. LNG exports are predicted to average 12.33 Bcf/d in 2023.
- Coal production is expected to total 595 million short tons (MMst) in 2022, up 3% from 2021. The increase reflects strong international demand for U.S. coal and a need among power plant operators to replenish coal stocks. Monthly U.S. coal inventories through August 2022 were 19% lower compared with the same period in 2021 as production was not sufficient to both replenish stocks and satisfy summer power demand. 2023 projected coal production is expected to decrease to 573 MMst.
- Generation from renewable sources will make up an increasing share of total U.S. electricity generation, rising from 22% this year to 24% in 2023.

Based on recent events both domestically and internationally that have resulted in abrupt changes to the global oil and gas supply, other EIA studies and recent U.S. analyses (associated with weather impacts, etc.) regarding short-term domestic supply disruptions and shortages or sudden increases in demand demonstrate that reducing domestic supply (in the near-term under the current supply and demand scenario) will likely lead to the import of more oil and natural gas from other countries, including countries with lower environmental and emission control standards than the United States (EIA, 2021). Current global supply disruptions have also led to multiple releases from the U.S. Strategic Petroleum Reserve in order to meet consumer demand and curb price surges.

The EIA 2022 Annual Energy Outlook (<https://www.eia.gov/outlooks/aeo/>) projects energy consumption increases through 2050 as population and economic growth outweighs efficiency gains. As a result, U.S. production of natural gas and petroleum and liquids will rise amid growing demand for exports and industrial uses. In the AEO 2022, crude oil production is forecast to rise in 2022 and 2023 to record high level with production then remaining relatively flat through 2050. However, renewable energy will be the fastest-growing U.S. energy source through 2050. Energy-related CO₂ emissions decrease from 2022 to 2037 due to a transition away from more carbon-intensive coal to less carbon-intensive natural gas and renewable energy for electricity generation. After 2037, CO₂ emissions begin to trend upward as increasing energy consumption, resulting from population and economic growth, outpaces continuing reductions in energy intensity and CO₂ intensity. Further discussion of past, present and projected global and state GHG emissions can be found in Chapter 6 of the Annual Report.

3.2.2.4. *Mitigation Strategies*

GHG emissions contribute to changes in atmospheric radiative forcing resulting in climate change impacts. GHGs act to contain solar energy loss by trapping longer wave radiation emitted from the Earth's surface and act as a positive radiative forcing component. The buildup of these gases has contributed to the current changing state of the climate equilibrium towards warming. Chapters 8 and 9 of the Annual Report provides a detailed discussion of climate change science, trends, and impacts. The relationship between GHG emissions and climate impacts is complex, but a project's potential to contribute to climate change is reduced as its net emissions are reduced. When net emissions approach zero, the project has little or no contribution to climate change. Net-zero emissions can be achieved through a combination of controlling and offsetting emissions. Emission controls (e.g., vapor recovery devices, no-bleed pneumatics, leak detection and repair, etc.) can substantially limit the amount of GHGs emitted to the atmosphere, while offsets (e.g., sequestration, low carbon energy substitution, plugging abandoned or uneconomical wells, etc.) can remove GHGs from the atmosphere or reduce emissions in other areas. Chapter 10 of the Annual Report provides a more detailed discussion of GHG mitigation strategies.

Several Federal agencies work in concert to implement climate change strategies and meet U.S. emissions reduction goals all while supporting U.S. oil and natural gas development and operations. The EPA is the Federal agency charged with regulation of air pollutants and establishing standards for protection of human health and the environment. The EPA has issued regulations that will reduce GHG emissions from any development related to the proposed leasing action. These regulations include the New Source Performance Standard for Crude Oil and Natural Gas Facilities (40 CFR 60, subpart OOOOa) which imposes emission limits, equipment design standards, and monitoring requirements on oil and natural gas facilities. A

detailed discussion of existing regulations and Executive Orders that apply to BLM management of federal lands as well as current Federal and state regulations that apply to oil and natural gas development and production can be found in Chapter 2 of the *Annual Report*.

The majority of GHG emissions resulting from federal fossil fuel authorizations occur outside of the BLM's authority and control. These emissions are referred to as indirect emissions and generally occur off-lease during the transport, distribution, refining, and end-use of the produced federal minerals. The BLM's regulatory authority is limited to those activities authorized under the terms of the lease, which primarily occur in the "upstream" portions of natural gas and petroleum systems. This decision authority is applicable when development is proposed on public lands and the BLM assesses the specific location, design, and plan of development. In carrying out its responsibilities under NEPA, the BLM has developed Best Management Practices (BMPs) designed to reduce emissions from field production and operations. BMPs may include limiting emissions from stationary combustion sources, mobile combustion sources, fugitive sources, and process emissions that may occur during development of the lease parcel. Analysis and approval of future development may include the application of BMPs within BLM's authority, included as COAs, to reduce or mitigate GHG emissions. Additional measures proposed at the project development stage may be incorporated as applicant-committed measures by the project proponent or added to necessary air quality permits. Additional information on mitigation strategies, including emissions controls and offset options, are provided in Chapter 10 of the *Annual GHG Report*.

3.3. Issue 3: What are the human and ecological health impacts of oil and gas development to landowners and communities from noise, light, aesthetics, and traffic?

3.3.1. Affected Environment

The Proposed Action of leasing the parcel would, by itself, have no direct impact on any residents and/or businesses in the assessment area since there would be no surface disturbing activities authorized by the BLM. All anticipated resource impacts would be associated with potential future oil and gas development. Additional site-specific environmental analysis under the NEPA would be conducted upon receipt of an APD and prior to authorization of any ground-disturbing activities.

The four-mile assessment area is approximately 35,394 acres and is used as the basis for analysis of noise, light pollution, aesthetics, and traffic impacts. The Land Use/Land Cover map (Appendix A, Map 3) and Table 3-18 depict the land types within the analysis area, including the developed areas. About 58% of the analysis area is covered by cultivated crops, indicating the importance of agriculture as the primary land use.

The RFDS indicates that within the four-mile assessment area, in the Climax Field, there are eighteen producing oil wells all drilled between 2014 and 2022 targeting the Trenton Formation or Trenton/Black River Formation. Three oil-producing wells were vertical (conventional), ten were directional wells and five of the eighteen producing oil wells were horizontal (unconventional) wells. Table 3.23 in Section 3.7 of this EA details the types of industries and numbers of the population employed in those industries in Kalamazoo and Calhoun counties.

Despite the proposed lease parcel being in an area that is rural and agricultural in nature, there are producing oil wells that support a small minerals industry nearby within the analysis area.

The sparsely populated analysis area does not see much nocturnal light pollution (see Appendix A, Map 10), very little industrial noise due to its rural location, and most odors are generated from agricultural activities, such as pesticide use or fertilization of fields during growing season.

3.3.2. Environmental Impacts

3.3.2.1. *Impacts of the Alternative A – No Action Alternative*

Under the No Action Alternative, the proposed parcel would not be leased. There would be no subsequent impacts from oil and/or gas construction, drilling, and production activities, or downstream use of any oil and gas produced. The No Action Alternative would not affect the continuation of the current land and resource uses in the proposed lease area, including agriculture and other industries that generate increased traffic, light pollution, noise, and odors. Oil and gas exploration and development activities may continue in surrounding areas that are currently leased.

3.3.2.2. *Impacts of the Alternative B – Proposed Action*

Potential impacts to communities and landowners from well pad construction, well drilling and production include increased noise, light pollution, odors, site aesthetics, and an increase in traffic or a change in traffic patterns, all of which could have ecological and health implications. These impacts have also been associated with negative health outcomes for both humans and wildlife, such as annoyance, stress, irritation, unease, fatigue, headaches, respiratory issues and adverse visual effects.

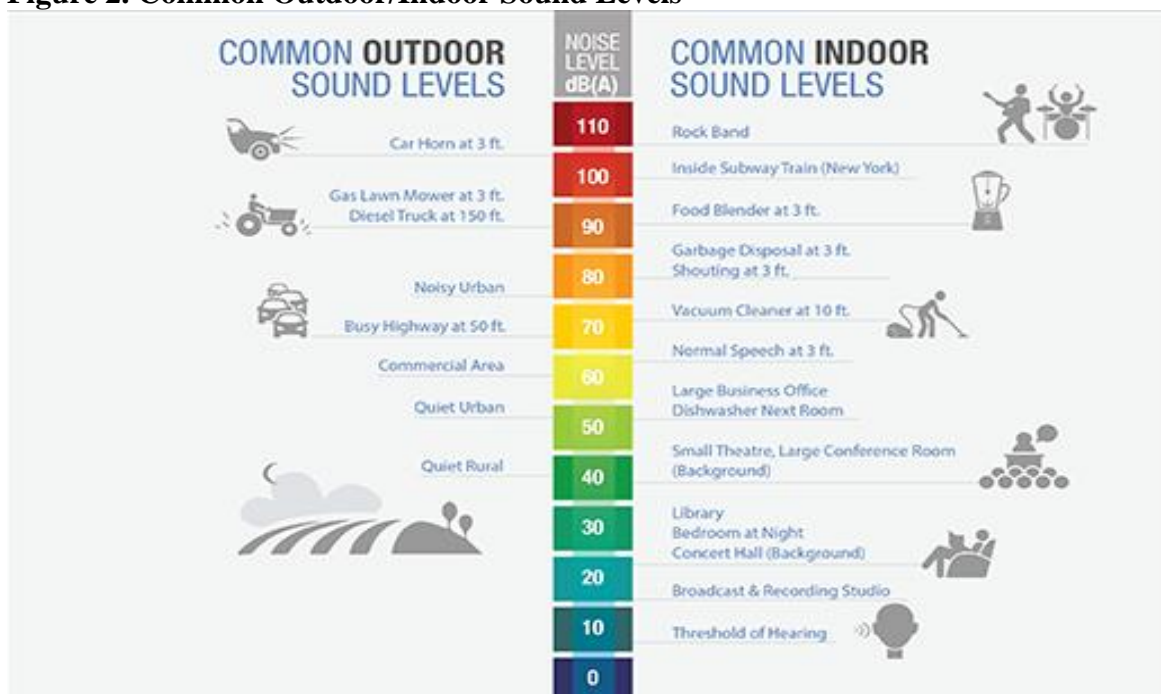
Noise

Certain levels of noise associated with drilling operations are expected if the lease is approved and subsequently, an APD is approved. Drilling can cause excessive noise, light pollution, impacts to aesthetics, and increases in traffic, which (with the exception of aesthetics), could have human and ecological health implications (Basu et al., 2013). These effects are most prevalent during the first two to thirty days of the development of the well, during the drilling and fracking phases. It will typically take one month, but potentially up to three months, to drill and complete an oil or gas well.

Typically, levels of noise are measured in units called decibels (dB). Because the human ear cannot perceive all pitches or frequencies equally well, noise measurements are adjusted or weighted to compensate for the human lack of sensitivity to low-pitched and high-pitched sounds. The A-weighting scale closely resembles the frequency response of the human ear and, therefore, the adjusted unit of measurement, the A-weighted decibel, or dBA, is used to characterize noise, and to quantify the impact of noise. The extent to which individuals are affected by noise is controlled by several factors, including the duration and frequency of sound; the distance between the source and the receptor; the intervening natural or man-made barriers or structures; and the ambient environment. Outdoor noise environment varies greatly in magnitude and character depending on the time of day, season of the year, human activity, land use, transportation networks, and degree of urbanization, industrialization, and forest cover.

As oil and gas exploration and development activities increase, there is generally an accompanying influx of machinery and people. The machinery used at and around well sites is frequently powered by diesel motors, which, in addition to generating air emissions (see Section 3.2), also generate noise. Noise impacts could be generated by drill rig operation, compressors/generators, and general machine and vehicle operation. In a study conducted by BLM in 2003, the following noise levels were detected at 50 feet from the source: well drilling - 83 Decibels (Acoustic) (dBA); pump jack operations - 82 dBA; produced water injection facilities - 71 dBA; and gas compressor facilities - 89 dBA. Noise levels were found to depend on the distance between the receptor and the equipment, the topography, vegetation, and meteorological conditions (e.g., wind speed and direction, temperature, humidity) (BLM, 2003). Figure 2 represents common indoor and outdoor sound levels to compare the noise levels of routine human activities to those that one might encounter near a well pad.

Figure 2. Common Outdoor/Indoor Sound Levels



Source: FAA, 2023

The operating hours of well sites can vary in areas without local or other ordinances governing noise levels, with some potentially operating outside of daylight hours. Typical daytime residual, or ambient, noise may vary from 33 dBA on a rural farm to 77 dBA overlooking an eight-lane freeway (Eldred, 1974). In many residential neighborhoods, especially low density and rural areas, the nighttime noise level is very quiet. The USEPA has established that 55dBA as a noise level is adequate to protect against speech interference and sleep disturbance for residential, education, and healthcare NSAs (Federal Energy Regulatory Commission [FERC], 2007). If oil and gas facilities emit noise at 45 dBA, the noise will be perceived by many as being twice as loud as the ambient noise in the area.

Once wells go into production, noise levels from activities at the well pad(s) would drop off significantly.

Light Pollution

Light pollution impacts would be particularly noticeable in areas where oil and gas development has not occurred previously or is encountered infrequently. When operations take place after dark or otherwise in low-light conditions, artificial lighting is usually used (Upadhyay & Bu, 2010 and Kiviat & Schneller-McDonald, 2011). Depending on the type of lighting used, generators could contribute to elevated noise levels, and light could travel beyond the boundaries of the well site.

The level of inconvenience would depend on the activity affected, traffic patterns within the area, the length of time and season in which these activities occurred, and other factors. Creation of new access roads could potentially allow increased public access to the development area and increase the use of lighting after daylight hours.

Odors

Cumulative impacts to landowners and the surrounding community experiencing short-term increases in VOCs, particulate matter also known as particle pollution, and odors are expected to be the same as the direct impacts (see Chapter 3.1.3). Well spacing requirements in Michigan are designed to prevent the same location from being continuously or repeatedly exposed to the same pollutants. Any additional private oil or gas wells drilled in the assessment area in the future would be drilled far enough away from the same location that their emissions would be naturally dispersed to below unaided human detection levels at any given residence previously impacted by drilling.

Aesthetics

Aesthetic concerns have also surfaced surrounding the visibility of well sites and their associated operations. There have been reports and claims of equipment and machinery, pipelines, and access roads all interfering with residents' viewsheds (National Parks Conservation Association [NPCA], 2013; Upadhyay & Bu, 2010). Well pads, drill rigs, storage tanks and other structures would be visible to local residences and along any roadway near a site. As the analysis area is predominantly rural, any facilities developing oil or gas would stand out. Once a well goes into production, the drill rig would leave the site, truck traffic to the well pad would reduce significantly and interim reclamation activities would commence, thus reducing visual impacts.

Traffic

Many aspects of hydraulic fracturing operations lead to an increase in truck traffic in and around the site vicinity, including the use of trucks to transport drilling equipment, workers, and water to and from the site. Road congestion was identified by shale gas industry experts as a high priority risk to the public and environment in a recent survey in which a variety of experts were asked to identify the most important risks related to hydraulic fracturing operations. While truck traffic is likely to be elevated in and around a hydraulic fracturing site for the lifetime of the well, the majority of truck traffic occurs during the construction of the well pad, the drilling and hydraulic fracturing process, and the waste fluid and equipment removal process. The number of heavy

trucks needed during a hydraulic fracturing operation depends on the number of wells and well pads established at a site. For example, New York State Department of Environmental Conservation (NYSDEC, 2011; ALL Consulting, 2010) estimates that 3,950 one-way truck trips (with 1,148 of those being heavy, fully loaded trucks) would be required for a newly created well and well pad (see Table 2.2). This estimate is for a horizontal drilling hydraulic fracturing operation requiring approximately 5 million gallons of water, all of which would be transported to the site by truck (Basu, et al., 2013).

Sites are not always located directly on or near existing roads; operators sometimes need to create access or service roads in order to allow equipment, personnel, and trucks to get to and from the sites. These roads have been connected with increased levels of well site traffic, in addition to potentially adverse environmental consequences (Christopherson & Rightor, 2011).

Once the wells are placed into production, noise, well pad lighting, and odors at well sites would be greatly reduced as the operator eventually limits visits to these sites to weekly, then bi-weekly, and then occasionally for infrequent workover (well stimulation) operations. After the first week to month of activity, noise disturbance would return to background levels, such as existing manufacturing and agricultural activities that occur in the assessment area.

3.3.2.3. *Proposed Mitigation*

For leases in which the surface is privately-owned and the mineral estate is Federally-owned (also known as a “split-estate”), such with this proposed lease, surface owner agreements and standard lease stipulations would potentially address concerns of private surface owners and the surrounding community. Oil and gas activities are required to minimize disturbance per state and local rules and regulations. Noise, light, traffic, aesthetics, and odor impacts on the landowners or local community may be minimized with Best Management Practices (BMPs) and should be employed in accordance with state and local requirements.

The following are example BMPs, based upon Michigan Administrative Code Rules (EGLE, 2023a), that may be incorporated:

Noise

Under Michigan Administrative Code Rule R 324.61506(t), the State of Michigan lays the responsibility upon the site supervisor for preventing regular/recurring nuisance noise and odor in the exploration or development, production, or handling of oil and gas.

Michigan does not formally require monitoring for ambient noise levels; however, if a site supervisor receives one or more complaints of noise, the supervisor may require the permit holder to collect decibel readings to determine the noise level. If a determination is made of a nuisance noise emanating from the well site, the site supervisor may, at their discretion, require noise control measures (Michigan Administrative Code Rule R 324.1015).

Additionally, the MDEQ lays out several construction standards for noise abatement, including requiring that compressor motors rated for more than 150 horsepower be completely enclosed, that the interior of the enclosure be lined with sound-absorbent material, and that the compressor drive motor be equipped with a hospital-type muffler (Michigan Administrative Code Rule R 324.1016).

Light Pollution

MDEQ imposes permit conditions on lighting and screening on a case-by-case basis. If night light is necessary, the BMPs would include using low pressure sodium light sources when possible, directed to point downwards, and to be shielded (Maryland DNR, 2015; Colorado Oil and Gas Conservation Commission [COGCC], 2020).

Lighting should not interfere with species migration and breeding. Lighting should not interfere with the quality of life of the surrounding community.

Odors

Companies should take the precautions to prevent odors whenever possible. MDEQ has established detailed regulations surrounding nuisance odors connected with wells that produce hydrogen sulfide, including requiring the permit holder to conduct numerical modeling to determine H₂S concentrations in the air and empowering the site supervisor to require emission control measures for hydrogen sulfide. The site supervisor is also required to prevent regular or recurring nuisance odor in the exploration for or development, production, or handling of gas (Solomon, D. & Schindler, K., 2012). Michigan has also addressed odors in Michigan Administrative Code R. 324.1013 “A person shall not cause a nuisance odor in the exploration for, or in the development, production, handling, or use of, oil, gas, or brine or in the handling of any product associated with the exploration, development, production, or use of oil, gas, or brine.”

Aesthetics

Under Michigan Administrative Code Rule R 324.301(b) setback requirements for wells and facilities from occupied structures are 300 feet or if in a township with a population over 70,000, the requirement is 450 feet. These regulations are in part intended to address aesthetic issues.

Examples of BMPs include but are not limited to:

- Painting the production facilities if it can be seen from a road or highway to match the surrounding landscape (COGCC, 2020)
- Companies can include “nuisance easements” as part of their lease agreements with landowners—offering them compensation in exchange for permitting specific nuisances, such as visual impacts, noise, light, or odors (Lee, 2014).
- Natural gas producers and operators are using large fences made of steel frames and neutral-colored fabrics to provide a buffer between equipment and ecologically sensitive or residential areas. The walls may help companies comply with the state’s noise limits and are being considered for wildlife habitat where operations might otherwise interfere (Finley, 2014).

Traffic

Operators should submit a Road Maintenance Agreement, which is an agreement between the company and the county or local township, that would include proposed truck routes, evidence of complying with weight limits posted on roads, and would ensure road repairs if damage occurs from their operations.

3.4. Issue 4: How would the amounts of water needed for hydraulic fracturing operations affect the availability of local groundwater and surface water resources?

3.4.1. Affected Environment

There are just over 100 stream miles, and 7,545 acres of wetlands in the four-mile assessment area that includes the proposed lease parcel. If the parcel is leased and an APD is approved, water access is needed to drill a well. The source of water for drilling activities could come from municipal sources, groundwater aquifers, or even recycled hydraulic fracturing wastewater (flowback) (GAO, 2003). In the State of Michigan, the use of surface waters as a source for drilling fluid is not allowed (Michigan Administrative Code Rule R 324.404).

The Land Use/Land Cover map (Appendix A, Map 3) depicts the land types within the four-mile assessment area. When assessing water availability, water withdrawals, and the effects on surface water and groundwater, a watershed assessment approach is needed. Table 3.15 in Section 3.4.1 identifies the HUC 12 watersheds within the four-mile area (also see Appendix A Map 7). This is considered the analysis area for impacts to groundwater and surface water resources.

The interaction of groundwater with surface water depends on the physiographic and climatic setting of the landscape. Within the assessment area is glacial terrain. Glacial terrain is characterized by a landscape of hills and depressions. Although stream networks drain parts of glacial landscape, many areas of glacial terrain do not contribute runoff to an integrated surface drainage network. Instead, surface runoff from precipitation falling on the landscape accumulates in the depressions, commonly resulting in the presence of lakes and wetlands. Because of the lack of stream outlets, the water balance of these “closed” types of lakes and wetlands is controlled largely by exchange of water with the atmosphere (precipitation and evapotranspiration) and with groundwater (Winter, et al., 1999).

Wetlands are unique ecosystems in that they are the transitional area between permanently saturated aquatic systems and dryer upland areas, being inundated or saturated by surface or groundwater at a frequency and duration sufficient to support a prevalence of vegetation typically adapted for life in saturated soil conditions (33 CFR 328). Wetland ecosystems are essential breeding, rearing, and feeding grounds for many species- particularly rare or endangered species (Niering, 1985). Wetlands also provide valuable ecosystem services such as flood attenuation and water purification. The hydrologic regime of a site is the greatest influence to wetland health and stability. Changes to surface water or ground water can therefore affect wetlands. Within the 40-acre lease parcel there are approximately 730 feet of stream features (less than 1%), seven acres of freshwater forested/shrub wetlands (17.5%), and one acre of freshwater emergent wetlands (1%) (See Appendix E, Map 5). Within the surrounding four-mile assessment area there are approximately 1,307 acres of freshwater emergent wetlands, 4,400 acres of freshwater forested/shrub wetlands, 172 acres of ponds, 137 acres of lakes, and 100 miles of riparian habitat (See Appendix A, Map 5).

Both surface water and groundwater are regulated by the State of Michigan through a combination of Federal and State requirements such as the Federal CWA and the State’s Part 303, Wetlands Protection, of the NREPA, 1994 PA 451. Pursuant to 1994 PA 451, EGLE

prohibited all new withdrawals from causing an adverse resource impact to the waters of the state.

The Great Lakes – St. Lawrence River Basin Water Resources Compact, more often referred to as the “Great Lakes Compact” was approved and went into effect on October 3, 2008 (Public Law 110-342, 110th Congress) (Great Lakes-St. Lawrence River Regional Water Resources Regional Body, 2023). This agreement governs the conditions under which the eight Great Lakes states can accept or reject proposals for diversions of water from the Great Lakes basin, or between the watersheds of different Great Lakes. It also mandates that each of those Great Lakes states will manage and regulate new or increased water withdrawals within their jurisdictions that meet specific criteria.

As a result of the Great Lakes Compact, all new proposed water withdrawals in Michigan are required to be screened using the Water Withdrawal Assessment Tool (WWAT) (MDEQ, 2023). Use of the WWAT is required of anyone proposing to make a new or increased large quantity water withdrawal (LQWW) from the waters of the state, including all groundwater and surface water sources, prior to beginning the withdrawal.

The WWAT is one of the tools that is used by MDEQ in the state water withdrawal permitting process. Stream depletion may be based on proximity to groundwater, with closer streams experiencing a greater degree and distant streams experiencing less. The more detailed site review conducted by MDEQ staff follows similar steps but uses more specific and localized hydrologic data from the WWAT.

Unconventional well drilling, such as high-volume hydraulic fracking could be a large quantity withdrawal. As described in Section 2.2.1 of this EA, if permitted by the MDEQ, a water withdrawal for a hydraulically fractured horizontal well could potentially exceed 20 million gallons. This is roughly equivalent to the monthly water use of 250 to 2600 households, or annual use of 20 to 215 households. The RFDS indicates that in the Climax Field there are 18 producing oil wells, all drilled between 2014 and 2022, targeting the Trenton Formation or Trenton/Black River Formation. Three oil-producing wells were vertical (conventional), 10 were directional wells and 5 were horizontal (unconventional) wells.

Groundwater may be stored in bedrock aquifers or in overlying “glacial drift” aquifers. Drift aquifers are composed primarily of sand and gravel deposits left by the glaciers (see more on soils in Section 3.9). The aquifers can vary greatly in depth and capacity to store and transmit water and these variations are accounted for in the assessment tool.

The four-mile assessment area around the parcel contains approximately 1,143 groundwater wells (EGLE, 2022b), see Appendix E, Map 4. Table 3-13 shows the breakdown of the number of groundwater wells by county. Table 3-14 indicates groundwater uses at the county level in each of the counties within the assessment area for the year 2020. There are three known USGS groundwater wells monitoring the water depth of the aquifer (to the surface) within the four-mile assessment area. There are also several surface monitoring locations within the four-mile assessment area with data on ambient water conditions and trends if trends data is available.

Table 3.13. Wellogic Groundwater Wells Within Four-Mile Assessment Area

County	Number of wells
Kalamazoo	1,118
Calhoun	25

Source: Water Well Viewer (EGLE, 2022a).

Table 3.14. Groundwater Use in the two counties within the four-mile assessment area, 2020

County	Public Water Supply	Irrigation	Industry	Livestock	Commercial - Institutional	Other
Kalamazoo	8,995,174,472	4,934,578,447	6,658,815,279	70,210,933	67,725,920	1,008,000
Calhoun	4,235,061,906	2,405,779,614	2,124,914,267	0	5,663,160	27,616,008

3.4.2. Reasonably Foreseeable Trends and Planned Actions

Over the next 20 years, the lease parcel could accommodate up to two well pads. Each well pad has a possibility of either one vertical/directional well or up to three horizontal wells, based on resource occurrence potential and 40-acre well spacing requirements, and assuming minimal constraints on drilling.

Eight oil well permits were issued within the four-mile assessment area during the last two years. While not all permits would necessarily result in a well actually being drilled or produce a well, if current interest remains similar it is possible up to 80 well permits could be authorized within the four-mile assessment area over the next 20 years.

In addition to the possibility of receiving an APD for up to two well pads and potentially multiple wells drilled, on or off the lease parcel, there are other activities that would need LQWW in the two counties within the four-mile assessment area (as identified in Table 3.14), particularly for crop cultivation and manufacturing purposes. The state would determine, through use of the WWAT, and accounting for the other approved LQWW projects in a county, if any LQWW needed to drill oil and gas wells would cause adverse resource impacts and whether to permit the requested water withdrawal.

There are currently 18 wells in active production in Kalamazoo County. While each vertical well drilled would potentially use between 100,000 to 500,000 gallons of water and each horizontal well drilled would potentially use up to 20,000,000 gallons of water (if permitted by MDEQ), not all the wells would ever be drilled and if drilled, not at the same time.

3.4.3. Environmental Impacts

3.4.3.1. *Impacts of the Alternative A – No Action Alternative*

Under the No Action Alternative, the proposed parcel would not be leased. There would be no subsequent impacts from oil and/or gas construction, drilling, and production activities, or downstream use of any oil and gas produced. The No Action Alternative would not affect the continuation of the current land and resource uses in the proposed lease area, including agriculture and other industries that require LQWW. The No Action Alternative would not limit the renomination of these lands in the future or the leasing of private minerals underlying private lands where oil and gas exploration and development activities may require LQWW.

3.4.3.2. *Impacts of the Alternative B – Proposed Action*

The Proposed Action of leasing the parcel would, by itself, have no direct impact on any residents and or businesses in the assessment area since there would be no surface disturbing activities authorized by the BLM. All anticipated resource impacts would be associated with potential future oil and gas development. Additional site-specific environmental analysis under the NEPA would be conducted upon receipt of an APD and prior to authorization of any ground-disturbing activities.

The RFDS predicts up to two well pads and 2 conventional vertical wells drilled, one per pad, or up to 3 horizontal wells drilled per pad in the next 20 years by the lessee. Since the location, well type, water source, and method of conveying water to the pad are all unknown at this time, the BLM cannot analyze the expected impacts to a particular water source. Based on the number of groundwater wells (see Table 3.13) and the current groundwater uses in Kalamazoo and Calhoun counties, including within the assessment area (see Table 3.14), it may be assumed that any water for well drilling would be withdrawn from groundwater resources or purchased and trucked to the well site.

If permitted by MDEQ, the use of HVHF to develop a horizontal well could deplete groundwater of up to an estimated 20 million gallons and could potentially effect surface water resources if there was a connection between the two. If all of the horizontal wells predicted in the RFDS are successfully drilled and completed, up to 120 million gallons of water would potentially be used in the assessment area. Groundwater withdrawn for drilling and/or fracking would reduce water available for other uses (as identified in Table 3.14) such as water for agriculture, community and private wells, aquatic habitats, watershed health and surrounding ecosystems such as freshwater wetlands.

Large quantity water withdrawals are defined as one or more cumulative total withdrawals of 100,000 gallons per day or more, in any consecutive 30-day period that supply a common distribution system. That equates to a pump capacity of 70 gallons per minute or more and includes the combined total for all pumps on a given property (EGLE, 2023b). Registration of all LQWW is required in the State of Michigan. The EGLE incorporates generalized modeling principles of pumping well behavior using statewide data. To evaluate a proposed withdrawal, WWAT considers well depth, aquifer characteristics, distance from nearby streams, and pumping rate and frequency to estimate stream-aquifer interactions. The WWAT distributes the estimated impacts of well pumping among neighboring streams based on distance. The state of Michigan

Administrative Rule 324.1403 also requires monitoring and reporting on water levels of groundwater wells within 1,320 feet to assess potential impacts to groundwater availability.

New LQWW are not allowed to create adverse resource impacts, which are defined for each unique category of water body. A water withdrawal is defined as the removal of water from its source (surface or groundwater) for any purpose, other than for hydroelectric generation at sites governed by the FERC.

The availability and location of water will also affect the amount of truck traffic within the assessment area. Drill sites that can withdraw from nearby groundwater wells would reduce the number of heavy trucks needed for water hauling and produced water disposal by nearly 85% (Basu, et al., 2013). Table 2.2 estimates the number of one-way loaded truck trips that could occur to develop a horizontally drilled well and includes amounts of water needed in the drilling process. Sections 3.1 and 3.2 analyze air quality, emissions, and climate impacts from truck traffic used in all phases of well development.

Changes to hydrologic regime and therefore wetlands would not occur from offering the mineral lease for sale under the Proposed Action. However, under certain circumstances if the lease is developed and a LQWW is approved by the State of Michigan, existing wetland characteristics could be affected. Cascading effects to upland vegetative communities, wetland vegetative communities, water chemistry, nutrient cycling, biodiversity, carbon sequestration and other services wetlands provide could occur because of a LQWW.

3.4.3.3. *Proposed Mitigation*

Water usage for drilling and hydraulic fracturing of oil and gas wells is considered at the APD stage when site-specific ground disturbing activities are proposed. Many factors, such as well type, depth, and the use of recycled water, influence the amount, timing and location of water used in oil and gas resource development. Water usage is largely regulated by the State of Michigan's water rights system and operators would need to legally obtain a source of water to drill and develop a well.

The BLM, under Onshore Oil and Gas Order No. 2, and the EGLE require the use of casing and cementing to isolate the well from any potentially drinkable water-bearing formations. Michigan Administrative Code Rule R 324.408 requires surface casing to be set 100 feet below the base of glacial drift into competent bedrock and 100 feet below all freshwater strata.

MDEQ requires oil and gas operators to implement and maintain BMPs at all oil and gas locations to control stormwater runoff in a manner that minimizes erosion, transport of sediment offsite, and site degradation. Pursuant to 43 CFR 3101.1-2, the BLM may encourage siting locations, BMPs, and/or design features when an APD is received that would avoid, minimize, or mitigate impacts to wetlands.

3.5. Issue 5: How would the quality of surface and groundwater resources be affected by oil and gas operations?

3.5.1. Affected Environment

The surface of the approximately 40-acre private parcel is occupied by cultivated crops (approximately 31 acres), woody wetlands (approximately 7 acres), and one acre of development. Within the four-mile assessment area around the parcel the predominate land covers are cultivated crops, woody wetlands, and deciduous forest. A detailed list of the land cover in the four-mile assessment area can be found in Table 3.18. There is currently no known Federal surface estate and other than the subject parcel, there is no known Federal mineral estate within the four-mile assessment area. The nominated parcel is located within the Indian Lake-Portage River Watershed, Hydrologic Unit Code (HUC) 040500010505, (see Appendix A, Map 4). There are a little over 100 stream miles and 7,545 acres of wetlands within the four-mile assessment area surrounding the proposed parcel (see Land Use/Land Cover, map 3 in Appendix A and Wetland Types, Map 5, Appendix A for locations of these resources).

The watersheds within the four-mile assessment area are listed in table 3-15 and the percentage of each county within each watershed is noted in Table 3-16.

Table 3-15. Watersheds within the four-mile assessment area surrounding the parcel

HUC 12 Number	Watershed Name
040500010501	Headwaters Portage River
040500010505	Indian Lake-Portage River
040500010901	Headwaters Little Portage Creek (large % of the watershed is in the parcel and assessment area)
040500010305	Bear Creek
040500010304	Pine Creek

See also Map 7 in Appendix A. Note: HUC 12 watersheds are 12-digit hydrologic unit codes used to identify local sub-watershed levels, encompassing tributary systems. The State of Michigan assesses their compliance to CWA regulations at the HUC12 level.

Table 3-16. Portion of Counties within Watersheds of the Four Mile Assessment Area

County	% of County in Kalamazoo Watershed Boundary	% of County in St. Joseph Watershed Boundary	% of Total Kalamazoo Watershed Area (2031.51 sq mi)	% of Total St. Joseph Watershed Area (3171.3 sq mi)
Kalamazoo (580.30 sq mi)	54.16% (314.3 sq mi)	41.53% (240.99 sq mi)	15.47%	7.6%
Calhoun (718.34 sq mi)	67.76% (486.78 sq mi)	31.95% (229.5 sq mi)	23.96%	7.24%

See Map 3 in Appendix E

Existing Surface Water Quality

The parcel is in the Indian Lake-Portage River Watershed. The existing surface water quality conditions of Indian Lake-Portage River Watershed are monitored by the USGS Michigan Water Science Center, MDEQ, and other organizations. The overall condition of the seven waterbodies (HUC 12) in the Indian Lake-Portage River Watershed is reported in the *2022 Michigan Integrated Report* (EGLE, 2023c) The *Integrated Report* satisfies the listing requirements of Section 303(d) and the reporting requirements of Section 305(b) and Section 314 of the CWA. The Section 303(d) list includes Michigan water bodies that are not attaining one or more designated use and require the establishment of Total Maximum Daily Loads (TMDLs) to meet and maintain State Water Quality Standards.

The seven waterbodies in the Lake-Portage River Watershed were assessed for levels of impairment in 2020 or earlier and were recently published in 2022 (EPA, 2022e). A summary of the current 303(d) list of impaired waterbodies may be found in Table 3-17.

Table 3-17. 303(d) Impaired Waterbodies in Four Mile Assessment Area, 2022

Watershed	MI Waterbody ID	Waterbody Condition Impairment Status in 2022	Agriculture	Coldwater Fisheries	Fish Consumption	Industrial Water Supply	Navigation	Other Indigenous Aquatic Life and Wildlife	Partial Body Contact Recreation	Total Body	Warm Water Fishery
Indian Lake	MI040500010505-02	Good	Good	Good	NA	Good	Good	Good	NA	NA	NA
Rivers/Streams in HUC 040500010501	MI040500010501-01	Impaired	Good	NA	Impaired	Good	Good	Good	NA	NA	NA
Rivers/Streams in HUC 040500010505	MI040500010505-04	Impaired	Good	NA	Impaired	Good	Good	Impaired	Good	Impaired	Good
Rivers/Streams in HUC 040500010505	MI040500010505-01	Impaired	Good	NA	Impaired	Good	Good	Impaired	NA	NA	NA
Rivers/Streams in HUC 040500010505	MI040500010505-03	Impaired	Good	NA	Impaired	Good	Good	Impaired	Impaired	Impaired	Good
Saginaw Lake	MI040500010505-05	Good	Good	NA	NA	Good	Good	NA	NA	NA	NA

Watershed	MI Waterbody ID	Waterbody Condition Impairment Status in 2022	Agriculture	Coldwater Fisheries	Fish Consumption	Industrial Water Supply	Navigation	Other Indigenous Aquatic Life and Wildlife	Partial Body Contact Recreation	Total Body	Warm Water Fishery
Unassessed Lakes in HUC 040500010505	MI040500010505-NA	Good	Good	NA	NA	Good	Good	NA	NA	NA	NA

Source: EPA, 2022e, Impaired Waters and TMDLs in Region 5

The Michigan regulatory response to the impaired or threatened waters is total maximum daily load or TMDL followed by a watershed restoration plan. Michigan also has statewide TMDLs for mercury, polychlorinated biphenyls (PCBs), and *E. coli*. TMDLs were designed to be expanded as new water quality data become available. The impaired waters list is updated every two years and more site-specific information will be available should the parcel be leased and an APD be received. Impairment is defined by the state water pollution limits known as the water quality standards.

3.5.2. Environmental Impacts

3.5.2.1. *Impacts of the Alternative A – No Action Alternative*

Under the No Action Alternative, the proposed parcel would not be leased. There would be no subsequent impacts from oil and/or gas construction, drilling, and production activities, or downstream use of any oil and gas produced. The No Action Alternative would not affect the continuation of the current land and resource uses in the proposed lease area, including agriculture and other industries that could generate hazardous wastes. However, the No Action Alternative would not limit the renomination of these lands in the future or the leasing of private minerals underlying private lands that generate drill site hazardous wastes.

3.5.2.2. *Impacts of the Alternative B – Proposed Action*

The Proposed Action of leasing the parcel would, by itself, have no direct impact on any residents and or businesses in the assessment area since there would be no surface disturbing activities authorized by the BLM. All anticipated resource impacts would be associated with potential future oil and gas development. Additional site-specific environmental analysis under the NEPA would be conducted upon receipt of an APD and prior to authorization of any ground-disturbing activities.

Development of a lease would typically generate the following types of wastes: (1) discharge of drilling fluids and cuttings into the reserve pits (if used); (2) wastes generated from used lubrication oils, hydraulic fluids, and other fluids used during production of oil and gas, some of which may be characteristic or listed hazardous waste; and (3) service company wastes from exploration and production activities as well as containment of some general trash.

If the applicant submits an APD, it is estimated the amount of water needed, depending on the type of well drilled, is between 100,000 gallons to drill a vertical well up to 20,000,000 gallons or more for a horizontal well. The well depths are predicted to be between 3,000 and 10,000 feet depending on the type of well(s) installed.

To document pre-drilling groundwater conditions, Michigan Rule 1404 requires baseline sampling of groundwater wells within 0.25 miles of a well prior to initiation of drilling or completion activities. The Michigan EGLE Groundwater Discharge Program regulates the discharge of treated wastewater to ground or groundwaters of the state under Part 31, Water Resources Protection, of the NREPA, 1994 PA 451 and the Part 22 Groundwater Quality Rules.

One of the most widely cited issues regarding the environmental consequences of hydraulic fracturing operations is groundwater contamination, and water quality issues more broadly. Wastewater disposal for HVHF operations, which use millions of gallons of water mixed with proppant and chemicals in hydraulic fracturing fluid, could have negative consequences to both surface and groundwater sources for drinking water quality, aquatic habitat, and wildlife health if it were released into those sources.

During the completion and production phases of a well, water mixed with proppant and hydraulic fracturing fluids containing chemicals such as acids, surfactants, and biocides, as well as naturally occurring hydrocarbons, salts, radioactive compounds, and heavy metals are injected into a wellbore to stimulate production. Of the total volume of hydraulic fracturing fluids injected into a well, amounts varying from 10 to 70 percent may return to the surface (flowback) along with additional produced native formation brines. The historic average in Michigan is about 37 percent (Ellis, 2013). Drilling to a production zone that is below a potable water-bearing aquifer poses the risk of allowing brine and other chemicals to migrate up into a potable water zone.

There are two periods of time when hydraulic fracturing wastewater can impair water quality: during surface storage and handling and during disposal through deep well injection (Shonkoff, Hays & Finkel, 2014). While concerns over surface storage and handling are important, open pit storage of these fluids is prohibited in Michigan. The CWA, specifically, Section 301, addresses effluent limitations for point source pollution. The section deems, “the discharge of any pollutant by any person” to be “unlawful” except for “publicly owned treatment works” (POTWs) (GovInfo, 2021). This means the wastewater cannot be discharged into the surface waters and the wastewater would need to be captured for reuse and/or sent to a publicly owned treatment works. In Michigan, flowback fluids are captured in steel tanks and either recycled for further fracking operations or ultimately disposed in deep injection wells that are permitted specifically for that purpose and are protective of freshwater resources (EGLE, 2020a).

Another potential risk posed by hydraulic fracturing is the possibility that fluids under high pressure could migrate to an existing well that was improperly abandoned, which would enable those fluids to migrate to the surface and contaminate any formations that the old well penetrates. These risks are mitigated through Michigan Administrative Code Rule R 324.405, requiring that drilling fluid be capable of sealing off and protecting other stratum above the stratigraphic or producing horizon and controlling subsurface pressures.

3.5.2.3. *Proposed Mitigation*

While the act of leasing federal minerals would produce no impacts on water quality from drilling, subsequent exploration and development of the proposed lease could result in the generation and temporary storage of waste materials (solid and liquid). Waste materials would be managed in accordance with BLM Onshore Orders 1 and 7 and the Resource Conservation and Recovery Act of 1976 (RCRA) (EPA, 2023). Control of hazardous wastes in Michigan is accomplished through a set of interrelated actions. The hazardous waste laws and supporting regulations provide enforceable standards for the treatment, storage, and disposal of hazardous waste. They also require tracking of hazardous waste from the generator and transporter to the disposal facility to ensure proper management and disposal that is protective of health, safety and our environment. To maintain the quality of our groundwater, most hazardous waste must be treated prior to being disposed of in a licensed landfill.

Hazardous waste treatment, storage, and disposal facilities are highly regulated, highly engineered facilities with oversight and design requirements. The hazardous waste regulations that prescribe the standards that must be met in any license action taken by the MDEQ include:

- Part 111, Hazardous Waste Management, of the Michigan NREPA, 1994 PA 451, as amended, and its administrative rules.
- The corresponding RCRA of 1976, as amended by the Hazardous and Solid Waste Amendments of 1984 (HSWA), and its rules.

Fluid handling would be evaluated at the APD stage and fluids associated with any subsequent drilling, completion and/or production would either be treated, evaporated, or transferred to an approved MDEQ treatment facility. Solid wastes would be treated on site or transferred to a MDEQ approved facility.

Impacts to water quality are typically addressed through the stormwater management plan the operator is required to develop and may be modified by BLM during the project approval process. Oil and Gas Onshore Order No.1 requires inclusion of a reclamation plan that addresses both interim and final reclamation in the surface use plan of operations of any APD submitted.

MDEQ requires oil and gas operators to implement and maintain BMPs at all oil and gas locations to control stormwater runoff in a manner that minimizes erosion, transport of sediment offsite, and site degradation.

40 CFR 112 requires a Spill Prevention, Control, and Countermeasure (SPCC) plan that addresses the transport of chemicals and materials, including loading and unloading operations; vehicle/equipment fueling; outdoor storage activities, including those for chemicals and additives; produced water and drilling fluids storage; erosion and vehicle tracking from well pads, road surfaces, and pipelines; waste disposal practices; leaks and spills. MDEQ requires spill response procedures for responding to and cleaning up spills along with having the necessary equipment for spill cleanup readily available to personnel. Regulations on the reporting of losses, spills and releases in Michigan are promulgated in Michigan Administrative Code Rule R. 324.1008.

Michigan's administrative rules governing oil and gas development activities (Part 615, Supervisor of Wells, of the NREPA, Public Act 451 of 1994) were revised in 2015 to address the additional concerns associated with HVHF well completions.

Some specific protective measures for HVHF well completions in Michigan's administrative oil and gas operations rules include:

- In accordance with Michigan Administrative Code Rule R 324.1404, if any available water sources are within 1,320 feet of the proposed HVHF well site, those water wells must be sampled for a variety of baseline water quality parameters. The sampling must be conducted no fewer than 7 days and no more than 6 months before drilling a new well or re-completing an existing well (EGLE, 2023b).
- Pursuant to Michigan Administrative Code Rule R 324.1406, within 30 days of well completion of a HVHF operation, the permittee must provide a detailed list of chemical additives used to the internet –based FracFocus Chemical Disclosure Registry (FracFocus, 2023).

Michigan's oil and gas regulations provide for protection of the environment and public health and safety for the entire life cycle of oil and gas development activities, including the additional concerns associated with HVHF well completions.

Potential impacts to groundwater at site-specific locations are analyzed at the development stage when the APD is submitted. This process includes geologic and engineering reviews by both the BLM and EGLE to ensure that cementing and casing programs are adequate to protect all downhole resources including the groundwater hydrology. Oil and Gas Onshore Order No. 2 requires that the proposed casing, cementing and abandonment programs be conducted as approved to protect and/or isolate all usable water zones and requires pressure testing the casing string. Michigan Administrative Code Rule R 324.411 describes specific cementing requirements and pressure testing for well casings. In addition, Michigan Administrative Code Rules R 324.1400-1406 describe State of Michigan measures for regulating hydraulic fracturing operations including monitoring for any significant pressure increase. Monitoring these pressures helps to indicate if hydraulic fracturing fluids have escaped the target formation. These measures would minimize potential impacts to groundwater resources.

Common BMPs would also be implemented to reduce the risk of contamination from waste materials. For example, all trash would be placed in a portable trash cage and hauled to an approved landfill, with no burial or burning of trash permitted. Chemical toilets should be provided for human waste. Future development activities on the lease parcel would be regulated under the RCRA, Subtitle C regulations.

3.6. Issue 6: How would oil and gas leasing affect wildlife species?

The Proposed Action would have no direct impacts on plant and animal habitat and populations, since a lease would not authorize any surface-disturbing activities. This section describes potential effects that may result from reasonably foreseeable future development of the lease parcel. The primary effect to plants and animals from oil and gas development would be habitat modification from land clearing, grading, and reclamation. Because the environmental baseline is not assessed or determined on the private lands in consideration, the ability to determine effects

to potential habitat is extremely limited. Contamination of water, soil, and air may affect wildlife, and those effects are discussed in detail in other Issue sections.

3.6.1. Affected Environment

Based on the National Land Cover Database, the surface of the approximately 40-acre parcel is occupied by cultivated crops (approximately 31 acres), woody wetlands (approximately 7 acres), and one acre of development. Within the four-mile assessment area around the parcel, the predominate land covers are cultivated crops, woody wetlands, and deciduous forest. A detailed list of the land cover in the four-mile assessment area can be found in Table 3-18.

Table 3-18. Land Cover Breakdown of the Four-Mile Assessment Area Around the Proposed Lease

Land Cover Type	Coverage (%)	Area (acres)
Open Water	0.28	98.8
Perennial Ice/Snow	0	0
Developed, Open Space	3.42	1210.8
Developed, Low Intensity	2.30	815.4
Developed, Medium Intensity	0.40	143.3
Developed, High Intensity	0.04	17.3
Barren Land (Rock/Sand/Clay)	0.03	9.9
Deciduous Forest	8.31	2940.6
Evergreen Forest	0.26	91.4
Mixed Forest	0.77	271.8
Shrub/Scrub	0.03	9.9
Grassland/Herbaceous	0.07	24.7
Pasture/Hay	2.23	790.7
Cultivated Crops	57.67	20410.9
Woody Wetlands	19.48	6894.2
Emergent Herbaceous Wetlands	0.64	224.9

Source: National Land Cover Database (USGS, 2019). See also Map 3 in Appendix E

Threatened and Endangered Species

The act of leasing itself would have no effect to any of the threatened or endangered species listed, but lease development activities associated with drilling could have effects to some of the listed species. If an APD is submitted, BLM would consult with the U.S. Fish & Wildlife Service (FWS) on the potential effects of the proposal.

Table 3-19 lists the threatened and endangered (T&E) species identified within the four-mile assessment area on the official species list provided by the FWS Information for Planning and Consultation (IPaC) database.

Table 3-19. Threatened and Endangered Species Identified Within Four-Mile Assessment Area

Common Name	Scientific name	ESA Status
Northern Long-eared Bat	<i>Myotis septentrionalis</i>	Endangered
Indiana Bat	<i>Myotis sodalis</i>	Endangered
Tricolored Bat	<i>Perimyotis septentrionalis</i>	Proposed Endangered
Copperbelly Water Snake	<i>Nerodia erythrogaster neglecta</i>	Threatened
Eastern Massasauga (Rattlesnake)	<i>Sistrurus catenatus</i>	Threatened
Snuffbox Mussel	<i>Epioblasma triquetra</i>	Endangered
Mitchell's Satyr Butterfly	<i>Neonympha mitchellii mitchellii</i>	Endangered
Monarch Butterfly	<i>Danaus plexippus</i>	Candidate

Source: Official Species List, U.S. Fish & Wildlife Service, dated February 6, 2023 available in administrative record.

This list is provided as the initial step of the consultation process with the FWS as required under Section 7(c) of the Endangered Species Act. The FWS IPaC database does not identify critical habitat for the listed species within the four-mile assessment area.

Migratory Birds

Certain birds are protected under the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act. These laws prohibit the take of listed migratory birds or bald and golden eagles without FWS approval. The potential disturbance that could result in development of APDs within this project area would have negligible effect on overall habitat of the species listed below.

FWS has identified the following birds of particular concern (Table 3-20) either because they occur on the FWS Birds of Conservation Concern list or warrant special attention in the project location.

Table 3-20. Migratory Birds Within Assessment Area

Common Name	Scientific name	Status
American Bittern	<i>Botaurus lentiginosus</i>	<i>Bird of Conservation Concern (BCC)</i>
Bald Eagle	<i>Haliaeetus leucocephalus</i>	<i>BCC & Bald and Golden Eagle Act</i>
Black Tern	<i>Chlidonias niger</i>	<i>BCC</i>
Black-billed Cuckoo	<i>Coccyzus erythrophthalmus</i>	<i>BCC</i>
Bobolink	<i>Dolichonyx oryzivorus</i>	<i>BCC</i>
Canada Warbler	<i>Cardellina canadensis</i>	<i>BCC</i>
Chimney Swift	<i>Chaetura pelagica</i>	<i>BCC</i>
Eastern Whip-poor-will	<i>Antrostomus vociferus</i>	<i>BCC</i>
Golden Eagle	<i>Aquila chrysaetos</i>	<i>BCC</i>
Golden-winged Warbler	<i>Vermivora chrysoptera</i>	<i>BCC</i>
Henslow's Sparrow	<i>Ammodramus henslowii</i>	<i>BCC</i>
Lesser Yellowlegs	<i>Tringa avipes</i>	<i>BCC</i>
Henslow's Sparrow	<i>Ammodramus henslowii</i>	<i>BCC</i>
Long-eared Owl	<i>Asio otus</i>	<i>BCC</i>
Red-headed Woodpecker	<i>Melanerpes erythrocephalus</i>	<i>BCC</i>
Ruddy Turnstone	<i>Arenaria interpres morinella</i>	<i>BCC</i>
Upland Sandpiper	<i>Bartramia longicauda</i>	<i>BCC</i>
Wood Thrush	<i>Hylocichla mustelina</i>	<i>BCC</i>

Source: Official Species List, U.S. Fish & Wildlife Service, dated February 6, 2023 available in administrative record.

3.6.1.1. *Reasonably Foreseeable Trends and Planned Actions*

There is no cumulative effect for the proposed action of leasing the parcel since there is no earth moving or ground disturbance allowed in this stage of the process until an APD is received from the lessee and approved by BLM.

The cumulative effect of the connected action of developing a well could be limited additional fragmentation of habitat for threatened and endangered species, and other local wildlife species.

Other uses of the lands within the assessment area would continue during the time that these wells could be installed, including land needed to support agricultural activities and other industries mentioned in Table 3-23. The same effects to wildlife that have occurred in the past would continue in the future at non-mining industries occurring within the assessment area.

3.6.2. Environmental Impacts

3.6.2.1. *Impacts of the Alternative A – No Action Alternative*

The No Action Alternative would not directly or indirectly affect wildlife species and their resources. However, wildlife species would be affected by the continuation of current land and resource uses on or near the parcel. The No Action Alternative may reduce or delay Federal impacts to special status species from potential oil and gas development associated with the lease parcels. However, oil and gas development may occur at a later time or another location, which may affect special status species.

3.6.2.2. *Impacts of the Alternative B – Proposed Action*

The four-mile assessment area is the analysis area for evaluating impacts to wildlife species. The act of leasing does not authorize any development or use of the surface of lease lands without further application by the lessee and approval by BLM. In the future, BLM may receive APD(s) for the leased parcel. If APD(s) are received, BLM conducts additional site-specific NEPA analysis before deciding whether to approve the APD(s), and what COAs should apply. BLM would conduct further consultation under Section 7 of the ESA with the FWS at the APD stage. Any stipulations imposed on these leases are consistent with management described in the Michigan RMP.

Should an APD be received by BLM, construction of well pads, roads, pipelines, and other infrastructure to develop the oil and gas resources may result in the clearing of land. However, the acres of disturbance that could be expected from constructing two well pads on 40 acres represents only a small fraction of the four-mile assessment area (between 0.04% to 0.06%). Additionally, if lands that are already disturbed, such as agricultural, residential or commercial land, are utilized for well pad construction and existing roads are used to access well sites, that would further minimize the new area of disturbance.

For oil and gas development activities that occur on private lands, the applicant and landowner must comply with local, county and State of Michigan regulations. A lessee that submits an APD is responsible for determining if T&E species will be impacted by drilling and producing an oil or gas well at a specific site. The Department of Natural Resources is responsible for the protection of state endangered and threatened species under the NREPA of 1994. The Michigan Natural Features Inventory maintains a database of the locations of rare species and natural communities in Michigan. The State provides tools to the landowners and applicants to help determine the presence of T&E species.

If an applicant obtains a State of Michigan oil and gas lease that contains lease stipulations, which mention T&E species, then it is likely that drilling and production activities may impact those species. The applicant must have a qualified biologist or botanist survey the area to determine if and to what extent species may be impacted. Surveys must be sent to the Wildlife Division, DNR, for approval of the survey and plan of development prior to sending in the application to drill.

How the site is prepared and constructed may cause loss of existing or potential wildlife habitat. Habitat fragmentation is the process during which a large expanse of habitat is transformed into several smaller patches of smaller total area isolated from each other by a matrix

of habitats unlike the original. This land transformation makes it more difficult for wildlife to move throughout the region for foraging and migration. It also causes species to disperse further from each other making it more difficult to reproduce and maintain healthy populations, reducing species diversity. Decreased species diversity is associated with decreased ecosystem health and reduced ecosystem services, which can negatively affect surrounding communities (World Health Organization [WHO], 2023). Because the area of consideration is already a highly fragmented patchwork of disturbed and developed private lands used for agricultural, residential, commercial and other purposes, newly disturbed lands would not be reducing large, contiguous, undisturbed potential habitat and not likely to adversely affect T&E species. If APDs are proposed to access these minerals, site-specific analysis of the APDs will further review any potential to affect these species and their habitats.

Invasive species can have major impacts on native habitats. Construction of roads, well pads, pipelines, and other structures associated with potential future oil and gas development can spread invasive species. Increased vehicle traffic may carry seeds, plant propagules, or other live organisms that may become established within the proposed lease area. Areas that are disturbed by well pads or other development can be susceptible to direct infestation by non-native, invasive plant species that thrive in disturbed conditions. Wildlife in the area may not be adapted to the invasive species and invasive species may limit or eliminate native food sources and force the wildlife in the area to move to other location.

However, assessing the condition of habitat to support wildlife and existing baseline condition of established invasive species are beyond the BLM's authority to manage on private lands. The proposed action is located on private surface lands that could already harbor vegetation that includes or is managed for a broad range of invasive species. Many invasive species were once considered ornamental, cultivated by homeowners for a variety of purposes, that have now escaped the confines of private gardens and become invasive to native landscapes. Because of the likelihood of existing invasive species, the effects of newly disturbed lands and the potential for invasive species to further invade the habitat is likely to be of negligible impact. Potential impacts would also undergo additional review if an APD is proposed to develop the minerals under consideration.

As mentioned previously in Section 3.3.2.2, certain levels of noise associated with drilling operations are expected if an APD is approved. Such noises could have an effect on wildlife, including the disturbance of bats and migratory birds. Bats are known to relocate if they are bothered by sound. If the disturbance is around the clock, such as during the one to three months of well drilling and completion activities, the bats or other wildlife may adjust to the noise and perceive it as ambient.

3.6.2.3. *Proposed Mitigation*

Measures should be taken to prevent, minimize, or mitigate impacts to fish and wildlife animal species from exploration and development activities. Prior to authorization of an APD, activities would be evaluated on a case-by-case basis, and the project would be subject to recommended avoidance, minimization or mitigation measures. Suggested measures could potentially include seasonal or timing restrictions for certain activities, rapid reclamation of the site, noise restrictions, project relocation, or pre-disturbance wildlife species surveying. These techniques

could have a high potential to minimize negative impacts caused by the proposed action. Specific examples of BMPs or stipulations such as this include:

- Recommending site work be avoided when migratory species are potentially present.
- Recommending the use of BMPs, such as sound barriers, blankets, or mufflers to protect sensitive species that may be affected by noise or may require the operator to monitor species of concern.
- Several BMPs recommended by the BLM (2013) designed to reduce the preventable causes of direct wildlife mortality in fluid mineral operations. The BLM will suggest the proper BMPs as COAs if an APD is submitted.

3.7. Issue 7: How would the Proposed Action impact the social and economic conditions of the analysis area?

3.7.1. Affected Environment

The socioeconomics analysis area includes the counties either partially or completely within a 4-mile radius (assessment area) of the proposed lease parcel. The BLM used a 4-mile assessment area to account for possible horizontal (unconventional) wells drilled from beyond the subject parcel but potentially extending into the parcel in the subsurface. Although the proposed lease parcel is in Kalamazoo County, a portion of Calhoun County is within the 4-mile assessment area; therefore, the BLM compiled data for both counties and for the State of Michigan (for comparison).

Population

The proposed lease parcel is in an unincorporated area of Kalamazoo County, 10 miles east of Kalamazoo in southern Michigan. The area is sparsely populated and is primarily rural and agricultural. Climax Township and the Scotts unincorporated area are the closest population concentrations to the proposed lease parcel.

Table 3-21 displays the population estimates for the census tracts within the 4-mile radius of the proposed lease parcel, Kalamazoo and Calhoun Counties, and the state of Michigan between 2010 and 2020. Kalamazoo County and the census tracts in Kalamazoo County experienced population growth between 2010 and 2020. Kalamazoo County experienced a 6.9 percent population growth; the population growth in the census tracts within Kalamazoo County ranged from 5.0 percent to 16.4 percent. During the same time period, Calhoun County experienced a 2.3 percent population loss while the one census tract in Calhoun County experienced a 1.7 percent population growth. For comparison, Michigan's population grew by 0.2 percent (Headwaters Economics 2022a, 2022b).

Table 3-21. Population for the Analysis Area (2010–2020)

Geography	Total Population 2010	Total Population 2020	Population Change 2010–2020
Census tract 27, Calhoun County	6,182	6,287	1.7%
Census tract 33.02, Kalamazoo County	6,127	6,431	5.0%
Census tract 34, Kalamazoo County	3,649	3,840	5.2%
Census tract 66.01, Kalamazoo County	4,228	4,535	7.3%
Census tract 67.01, Kalamazoo County	2,632	3,064	16.4%

Calhoun County	137,112	133,943	-2.3%
Kalamazoo County	247,246	264,322	6.9%
Michigan	9,952,687	9,973,907	0.2%

Source: Headwaters Economics 2022a, 2022b

Economic Conditions

Table 3-22 displays the total employment, average annual unemployment rate, and per capita income for each of the two counties and the state. In 2021, Kalamazoo County had a lower unemployment rate (5.0 percent) when compared with the state (5.9 percent), while Calhoun County had a higher unemployment rate (6.6 percent) than the state. The per capita income in Kalamazoo and Calhoun Counties was lower than the per capita income in Michigan (which was \$55,762) by 1.6 and 16.0 percent, respectively (Bureau of Economic Analysis [BEA], 2022).

Table 3-22. Economic Demographics (2021)

Geography	Total Employment	Average Annual Unemployment	Per Capita Income
Calhoun County	66,226	6.6%	\$46,832
Kalamazoo County	154,941	5.0%	\$54,866
Michigan	5,579,513	5.9%	\$55,762

Source: BEA, 2022

As displayed in Table 3-23 below, in 2021, the top industries by employment in both counties and at the state level were manufacturing, retail trade, health care and social assistance, and government. Mining (including fossil fuels) employment—with 131 employees was less than 0.1 percent of the total employment in Kalamazoo County and with 85 employees in Calhoun County—was 0.1 percent of the total employment. Mining employment in Michigan accounted for 0.2 percent of the state’s total employment (BEA, 2022).

Table 3-23. Employment by Industry at the County Level (2021)

Geography	Calhoun County	Kalamazoo County	Michigan
Total number of jobs	66,226	154,941	5,579,513
Non-services related			
Farm	1,046	1,342	60,528
Forestry, fishing, and agricultural services	272	356	16,965
Mining (including fossil fuels)	85	131	11,175
Construction	3,005	8,567	294,806
Manufacturing	10,537	20,458	612,499
Services related			
Utilities	(D)	(D)	21,432
Wholesale trade	(D)	5,641	181,694
Retail trade	7,068	15,819	555,828
Transportation and warehousing	2,814	(D)	244,523
Information	321	1,003	65,642
Finance and insurance	1,811	7,766	286,876

Geography	Calhoun County	Kalamazoo County	Michigan
Real estate and rental and leasing	1,556	7,809	271,524
Professional and technical services	3,401	8,650	419,471
Management of companies	521	443	79,575
Administrative and waste services	2,982	8,424	349,850
Educational services	1,158	3,708	94,438
Health care and social assistance	8,668	22,711	661,466
Arts, entertainment, and recreation	991	3,241	97,668
Accommodation and food services	3,713	10,570	351,731
Other services, except public administration	3,900	8,293	315,456
Government	10,807	13,667	586,366

Source: BEA, 2022

(D) = Not shown to avoid disclosure of confidential information.

In addition to the jobs indicated for mining in Table 3.23 the oil and gas industry supports jobs and income through activities such as oil and natural gas extraction, pipeline transportation, and refining. In 2019, Michigan's oil and gas industry was responsible for directly creating 49,000 jobs and \$3.3 billion in labor income (American Petroleum Institute [API], 2019).

The industry also indirectly employs people through the purchase of goods and services; the spending of employees both directly and indirectly employed by the industry generates additional economic activity in sectors such as retail trade. In 2019, the oil and gas industry was responsible for a total of 251,000 jobs (includes jobs created both directly and indirectly) and \$15.9 billion in labor income.

The oil and gas industry also contributes directly to the economy via taxes, rents, and royalties. Federal mineral revenue is collected at the leasing stage from lease sales. As of 2022, mineral royalty rates are set at 18.75 percent for onshore federal minerals, with 49 percent of royalties returned to the state of extraction. Rents are applied for leases before production, and royalties are collected after production.

In addition, state taxes are collected on oil and gas development. Oil and natural gas companies pay a severance tax to the state on the gross cash value of oil and natural gas extracted from the ground. In Michigan, the severance tax is approximately 6.6 percent for oil and approximately 5.0 percent for natural gas. Marginal wells (wells near the end of their economic life) pay a 4 percent tax rate. In 2021, Michigan collected \$20.9 million in oil and gas severance taxes (State of Michigan, 2022). Oil and natural gas revenues help support recreation in Michigan by funding the purchase and development of land for state and local parks and recreation projects.

3.7.1.1. *Reasonably Foreseeable Trends and Planned Actions*

Oil production in Kalamazoo County peaked in 2019 at 207,840 billion barrels. In 2021, oil production in Kalamazoo County decreased to 85,339 billion barrels. In the 4-mile assessment

area, recent drilling activity focused on the Climax Field and the Trenton Formation. During the last 2 years, eight well permits were issued. With the current level of interest, up to 80 well permits could be authorized within the 4-mile assessment area over the next 20 years.

According to the RFDS, the first year's production from 17 Climax Field and Trenton Formation oil wells ranged from 669 to 5,967 barrels per month. The barrels per month generally decreased every year of production, sometimes more than 50 percent during the first several years. No natural gas production has occurred in Kalamazoo County (BLM, 2022b).

The potential for continued oil and natural gas production in Kalamazoo County exists with many known oil and gas-producing formations present; however, exploration is expected to fluctuate based on the price of oil and natural gas. Between 2012 and 2020, crude oil prices fluctuated with a general decreasing trend, until 2021 when oil experienced an increase in price. Similar to oil prices, the price of natural gas fluctuated from 2012 to 2020, with an increase in price in 2021 (EIA, 2022b).

3.7.2. Environmental Impacts

3.7.2.1. *Impacts of the Alternative A – No Action Alternative*

Under the No Action Alternative, the proposed 40-acre parcel of land would not be available for leasing; therefore, no new foreseeable oil and gas development would occur on the proposed 40-acre parcel. As a result, there would be no impact on the social or economic conditions in Calhoun and Kalamazoo Counties from the lease sale. However, the No Action Alternative would not limit the renomination of these lands in the future or the leasing of private minerals underlying private lands.

3.7.2.2. *Impacts of the Alternative B – Proposed Action*

Under the Proposed Action, specific impacts on social and economic conditions would depend on the intensity of potential future development. At the leasing stage, specific information on future development is unknown; therefore, the analysis in this section is primarily qualitative and provides an idea of the types of potential impacts that would occur.

Social Impacts

Impacts on the adjacent communities' quality of life resulting from oil and gas exploration, drilling, or production include the potential for increased emissions, noise, traffic and traffic delays, and visual impacts. For instance, increased traffic during construction and development could result in increased commuting times, traffic congestion, and effects on public health and safety for adjacent communities. Temporary and permanent structures would cause visual disturbance to adjacent communities. The magnitude of these types of socioeconomic effects would depend on the level and pace of the parcel's development.

Economic Impacts

As described in the reasonably foreseeable development analysis for oil and gas activities within the proposed lease parcel, over the next 20 years, there is the potential for up to two well pads. Each well pad would accommodate either a vertical (conventional) well or up to three horizontal

(unconventional) wells. Wells are projected to be primarily oil wells targeting the Trenton Formation, which may also produce natural gas. The economic impacts would depend on the pace and scale of development and the level of production. At the time of leasing, the scale of development is not known; therefore, the economic analysis describes the change qualitatively (BLM, 2022b).

The direct economic impact of issuing the new oil and gas lease would be generation of revenue from the lease sale's rental fees for the first 5 lease years and from royalties after the initial 5 lease years. As discussed in the affected environment, there is a large range of possible initial production volumes and production decline; therefore, the BLM cannot quantify the revenue from oil production on the 40-acre parcel (BLM, 2022b). Any federal revenue from future production would be taxed at 18.75 percent with 49 percent returned to Michigan. State severance taxes would be applied to all production at a rate of 6.6 percent for oil and 5.0 percent for natural gas.

Indirect effects that might result, should exploration or development of the lease occur, include increased employment opportunities related to the oil and gas and service support industries in the region as well as the economic contributions to federal, state, and county governments from severance and property taxes. For all phases, such as exploration, development, and production, the contribution of potential future development to the regional economy would depend on many factors, such as the level of production anticipated, the revenue generated per well, and the size of crews and the infrastructure or support facilities, if any, needed for oil and gas exploration and development activities, such as those related to access road construction.

Social Cost of Carbon

As described in Section 3.2.2.1, the average social cost of carbon associated with future potential development was estimated; the range was \$2.1 million to \$111.8 million depending on the discount rate applied. Discount rates represent the future value of an investment in terms of its present value. A high discount rate means that future effects are considered much less significant than present effects, whereas a low discount rate means the present and future effects are closer to equally significant. The social cost of carbon represents the total market and nonmarket costs to society associated with the predicted level of greenhouse gas emissions, rather than costs specific to the socioeconomic analysis area.

3.8. Issue 8: How would development of the two well pad sites within the 40 acres proposed for leasing impact environmental justice (i.e. population's access to clean air and water resources)?

3.8.1. Affected Environment

Environmental justice refers to the fair treatment and meaningful involvement of people of all races, cultures, and incomes with respect to the development, implementation, and enforcement of environmental laws, regulations, programs, and policies (CEQ, 1997). Executive Order 12898 requires federal agencies to determine whether proposed actions would have any disproportionately high and adverse effects on human health or environmental resources of minority, low-income, and Native American populations. An evaluation of environmental justice impacts includes identifying minority, low-income, and Native American populations within the

affected area; if minority, low-income, or Native American populations are identified, the agency must analyze any impacts of proposed alternatives to determine whether the impacts are adverse and disproportionately affect the identified populations.

The analysis area for environmental justice is the census tracts within a 4-mile radius of the proposed lease parcel; this includes four census tracts in Kalamazoo County, Michigan, and one census tract in Calhoun County, Michigan. This analysis area is intended to represent all communities that could be affected—either directly or indirectly—by future potential development of the lease parcel. To identify environmental justice populations, data were collected on low-income and minority populations for the census tracts and their respective counties.

The CEQ has developed guidance on identifying environmental justice populations using US Census Bureau data. The BLM’s Instruction Memorandum 2022-059 provides further direction for considering environmental justice concerns, including a detailed framework for identifying environmental justice populations. The BLM uses four criteria to identify environmental justice populations (BLM, 2022c):

- The percentage of the low-income population in the analysis area is equal to or greater than that of the reference area.
- The analysis area’s low-income population is 50 percent or greater of the total analysis area population.
- The analysis area’s minority population is meaningfully greater (110 percent or more) than that of the reference area.
- The analysis area’s minority population is 50 percent or greater of the total analysis area population.

The BLM defines low-income populations as individuals or groups of people whose income is less than or equal to 200 percent of the federal poverty threshold, as identified by the US Census Bureau (BLM, 2022c).

Minority populations include individuals who identify as being one or more of the following population groups: American Indian or Alaska Native, Asian, Native Hawaiian or other Pacific Islander, Black or African American, some other race (other than white), a combination of two or more races, or Hispanic (CEQ, 1997). Except for the white, non-Hispanic individuals, all other racial and ethnic groups are considered minorities; therefore, the total minority population of an area is calculated by subtracting the white, non-Hispanic population from the total population (BLM, 2022c).

Population

The proposed lease parcel is in an unincorporated area of Kalamazoo County, 10 miles east of Kalamazoo in southern Michigan. The area is sparsely populated and is primarily rural and agricultural. Climax Township and the Scotts unincorporated area are the closest population concentrations to the proposed lease parcel.

Table 3-21 displays the population estimates for the census tracts within the 4-mile radius of the proposed lease parcel, Kalamazoo and Calhoun Counties, and the state of Michigan between 2010 and 2020. Kalamazoo County and the census tracts in Kalamazoo County experienced

population growth between 2010 and 2020. Kalamazoo County experienced a 6.9 percent population growth; the population growth in the census tracts within Kalamazoo County ranged from 5.0 percent to 16.4 percent. During the same time period, Calhoun County experienced a 2.3 percent population loss while the one census tract in Calhoun County experienced a 1.7 percent population growth. For comparison, Michigan’s population grew by 0.2 percent (Headwaters Economics 2022a, 2022b).

Table 3-24 below, shows the low-income and minority data and the determination of an environmental justice population based on CEQ guidelines. Within the analysis area, one census tract has a potential environmental justice population. Census tract 67.01 in Kalamazoo County, directly north of the census tract where the proposed lease parcel is located (census tract 34 in Kalamazoo County), has a low-income population that exceeds the low-income threshold when compared with the percentage in its respective county, Kalamazoo County. Therefore, for this analysis, the population within census tract 67.01 in Kalamazoo County is considered an environmental justice population (US Census Bureau 2020a, 2020b). Maps 12 and 13 show the percentage and distribution of minority populations and low-income populations present in each census tract within the 4-mile radius of the proposed lease parcel.

Table 3-24. Environmental Justice Screening for the Analysis Area (2020)

Geography*	Low-Income Percentage¹	Meets or Exceeds the Low-Income Threshold	Minority Percentage	Meets or Exceeds the Minority Threshold
Census Tract 27, Calhoun County, Michigan	22.4	No	7.9	No
Census Tract 33.02, Kalamazoo County, Michigan	24.6	No	12.3	No
Census Tract 34, Kalamazoo County, Michigan	26.2	No	4.1	No
Census Tract 66.01, Kalamazoo County, Michigan	12.3	No	1.7	No
Census Tract 67.01, Kalamazoo County, Michigan	36.4	Yes	7.5	No
Calhoun County, Michigan	35.8	—	23.0	—
Kalamazoo County, Michigan	32.0	—	23.2	—

Source: US Census Bureau, 2020a

— = Data not applicable; used as reference population

* Includes counties and census tracts completely or partially within a 4-mile radius of the EOI

The low-income population shown is as a percentage of the total population for whom poverty status is determined.

3.8.2. Environmental Impacts

The CEQ guidance states that if environmental justice communities are identified in the analysis area, an additional analysis is needed to determine whether there are adverse and disproportionate impacts from the Proposed Action. The following factors should be considered

when examining whether human health effects or environmental effects are disproportionately high and adverse:

- Are the health effects or environmental effects significant or above generally accepted normal rates or risks? Do they negatively harm environmental justice communities?
- Are the risks or rates of harm to environmental justice communities greater than the risk or rate of harm to the general population or comparison community?
- Are the environmental justice communities impacted by cumulative effects?

The following sections will consider the factors above when examining whether the impacts from the No Action Alternative or the Proposed Action are disproportionately high and adverse (CEQ, 1997).

The BLM recognizes that local communities may identify additional adverse impacts as development actions are proposed. Therefore, the BLM would provide identified environmental justice populations opportunities to identify any perceived adverse environmental impacts at the time of the site-specific analysis during the development stage.

3.8.2.1. *Impacts of the Alternative A – No Action Alternative*

Under the No Action Alternative, the BLM would not make the subject lands available for competitive lease. The proposed 40 acres of federal mineral estate would not be available for potential future oil and gas development. Therefore, no new foreseeable oil and gas development would occur on the subject lease parcel. There would be no impact on the environmental justice communities' access to clean water or air quality due to the lease sales. However, the No Action Alternative would not limit the renomination of these lands in the future or the leasing of private minerals underlying private lands.

3.8.2.2. *Impacts of the Alternative B – Proposed Action*

Although the leasing action does not directly result in development that will impact air and water resources, potential future development of the leased parcel is reasonably foreseeable; therefore, impacts on environmental justice populations can be assessed for the purposes of this lease sale.

As described in Sections 3.1.2.2 and 3.1.3, the projected average annual emissions from potential development of the subject lease would impact air quality through direct and indirect emissions. Direct emissions result from production, transportation, or processing of oil and natural gas. Indirect emissions are those often associated with transportation of oil or natural gas across long distances.

Air pollution and the associated health effects can disproportionately affect individuals within environmental justice populations in the analysis area who are already vulnerable and have greater difficulty accessing healthcare facilities, have greater difficulty paying for medical treatment, or have a higher likelihood of having preexisting health conditions. The potential for disproportionate impacts on environmental justice populations would result from fugitive dust and diesel exhaust emissions during development and production. These emissions would have the greatest impact at locations near the lease site; therefore, residents that live closer to the proposed lease site would experience greater levels of impacts.

The level of impacts of indirect emissions and the potential for disproportionate impacts on the environmental justice communities would depend on the quantity of indirect emissions and where the emissions occur. There is uncertainty regarding the time and location of indirect emissions because indirect emissions are more dispersed than direct emissions. For example, indirect emissions from transporting natural gas through interstate pipelines would be as likely to occur out of the state as in the state. Because of this dispersion of indirect emissions, the BLM does not anticipate that there would be disproportionate adverse impacts on environmental justice communities from the indirect emissions that result from the Proposed Action.

Although the impact on clean air would be adverse and would impact the environmental justice communities within the analysis area, the change in air pollution would be incremental and not high enough to cause the counties to be reclassified as a nonattainment area for any of the criteria and hazardous air pollutants in the state. See Section 3.1 for more details.

While any climate change–related effect from the future potential development of the parcel would be minimal, climate change is the result of collective and global actions. Any climate change–related impact would be regional in nature. However, it may disproportionately affect individuals within environmental justice populations who are already societally vulnerable and have a lower capacity to prepare for, cope with, and recover from climate change impacts. If exploration and development occur according to the assumptions made in Section 3.1, project activities would be equivalent to about 10.6 percent of current greenhouse gas emissions from federal fossil fuel authorization emissions in the state, and less than 0.1 percent of federal fossil fuel authorization emissions in the nation.

The environmental justice communities around the project area could experience adverse impacts on access to clean water resources if the surface or groundwater is contaminated by development occurring from the Proposed Action. As described in Section 3.5, hydraulic fracturing of an oil and gas well could result in depleted groundwater and potentially impact surface water resources. If required procedures and regulations are not followed, surface and ground waters can be contaminated by wastewater flowback during surface storage and handling and during disposal through deep well injections. When not done in compliance with BLM and state regulations, the processes of drilling and completing a well may also have the potential to degrade surface water quality from non-point source pollution and sedimentation and result in adverse impacts to the watershed. Spills of materials used for well completion or drilling could contaminate surface water resources in the long term if not detected and addressed. Similarly, oil and gas wells may contaminate groundwater if a well leaks, or if a hydraulic fracturing operation generates cracks in the overlying rocks. These impacts could have a disproportionate effect on any downstream environmental justice communities who rely on water for business, recreation, or drinking water purposes.

However, the required permits and design features included in the project’s APD and COAs would help manage surface water impacts on each well pad. Short-term impacts would decrease after interim and final reclamation. Additionally, existing regulatory requirements and mitigation measures as described in Section 3.5 are established to minimize surface water impacts and subsequently prevent disproportionate effects to environmental justice communities. As such, under the Proposed Action, access to clean water for environmental communities should not be adversely affected. Potential impacts to water quality and quantity and subsequent impacts to low-income and minority populations would be analyzed in more detail at the APD stage.

3.8.2.3. *Proposed Mitigation*

To prevent adverse and disproportionately high impacts on environmental justice communities from the Proposed Action due to impacts on clean air and water, the BLM requires adherence to BLM and state regulations and requirements and may recommend BMPs for air and water resources when an APD is received, and site-specific ground disturbing activities are proposed.

3.9. **Issue 9: How would potential future development on the nominated parcel affect soil community and structure?**

3.9.1. *Affected Environment*

Within the proposed 40-acre lease parcel there are three soil types listed in Table 3-25; Riddles loam is well-drained loamy till; Sebewa loam is a poorly-drained hydric soil, and Sleeth loam is a somewhat poorly-drained sandy loam. These soils are classified as prime farmland, or prime farmland if drained, and can be susceptible to compaction and erosion.

Table 3-25. Characteristics of the dominant soil types found on the proposed lease parcel

Characteristic	Riddles loam on 2-6% slopes (RdB)	Sebewa loam on 0-2% slopes (Sb)	Sleeth loam on 0-3% slopes (SeA)
Percentage of 40-acre parcel	32.2%	8.6%	59.2%
Farmland Class	Prime	Prime if drained	Prime if drained
Fragility (e.g. erodibility)	Moderate	Moderate	Moderate
Risk of compaction	High	Medium	Medium
Hydric (y/n)	N	Y	N

Source: Natural Resources Conservation Service (NRCS), 2023. Maps of soil characteristics can be found in Appendix A, Maps 8, 9 and 10.

3.9.2. *Environmental Impacts*

3.9.2.1. *Impacts of the Alternative A – No Action Alternative*

Under the No Action Alternative, the BLM would not make the subject lands available for competitive lease. The proposed 40 acres of federal mineral estate would not be available for potential future oil and gas development. Therefore, no new foreseeable oil and gas development would occur on the subject lease parcel. There would be no impact to soils due to the lease sale. However, the No Action Alternative would not limit the renomination of these lands in the future or the leasing of private minerals underlying private lands.

3.9.2.2. *Impacts of the Alternative B – Proposed Action*

Soil disturbance would not occur from offering the mineral leases for sale under the Proposed Action. However, if the proposed lease parcel is developed, existing soil characteristics could change. The effects from future development could include: erosion by wind and/or water, topsoil removal, exposure of subsoil, mixing of soil horizons, compaction, and loss of soil

productivity (Toy, Foster, & Benard, 2002). With these effects there could be an increase in soil surface water runoff and an increased sediment load in streams. Subsequent effects to flora, fauna, and ecological stability could be observed. The soil characteristics within the 4-mile assessment area are variable, but generally similar to those found on the proposed lease parcel (see Table 3.25). As such, certain well pad locations may be preferable to minimize damage to local soils. If the lease is developed, it would be developed on private lands. The BLM may encourage appropriate well siting locations, BMPs and/or design features at the APD stage (per 43 CFR 3101.1-2) that mitigate impacts to soil and water resources.

The Proposed Action would increase oil and gas development in this area by 0.01% above the No Action Alternative described in the Affected Environment. Appropriate reclamation activities would be recommended by the BLM but are performed at the discretion of the private landowner. If interim reclamation activities occur after construction is complete, particularly where access roads and pipelines are constructed and are no longer needed for well production activities, this may reduce susceptibility and increase resilience to impacts from wind and water erosion in the long-term. Any impact to soils would be remedied upon final reclamation of the well pad and associated infrastructure, after approximately 30 years when the well has ceased production. Further analysis of impacts to soil resources will be performed at the APD stage when a site-specific development proposal has been received and site-specific impacts to soil resources can be better evaluated.

3.9.2.3. *Proposed Mitigation*

If federal minerals are proposed for future development by the lessee, the BLM would conduct additional site-specific analysis of potential impacts to soils. The Gold Book (BLM, 2007) provides recommendations for construction techniques that would minimize impacts that could be caused by soil erosion including the recommendation for the operator to stockpile topsoil from the surface of well pads to be used for future surface reclamation. The Gold Book also recommends that during the life of the development, all disturbed areas not needed for active support of production operations should undergo “interim” reclamation to minimize the environmental impacts of development on other resources used. Interim reclamation, which is partial reclamation during production activities, occurs immediately after well completion on areas used for road and pipeline construction that are unused during production. Conducting interim reclamation is a “best management practice” that also reduces costs and increases the effectiveness of final reclamation. Upon abandonment of wells and/or when access roads are no longer in service, final reclamation would be implemented.

CHAPTER 4. PUBLIC INVOLVEMENT, CONSULTATION, AND COORDINATION

Public Involvement

The proposed project was posted for a 30-day external scoping period from December 20, 2022 to January 19, 2023 to the BLM ePlanning site for this project at <https://eplanning.blm.gov/eplanning-ui/project/2020688/510A>. Details of the external scoping comment period can be found in Section 1.3 of this EA. The draft EA was posted to BLM's ePlanning page for public review and comment from March 10 – April 10, 2023. The BLM notified the surface owner (as identified by the party submitting the EOI) of the lease nomination by courtesy notice letter dated December 13, 2022 and provided the surface owner the opportunity to receive written notice when the NEPA document or lease sale notice is available for public review. The BLM sends a final notification if/when the parcel is listed in the lease sale notice. A listing of parcels to be offered at the auction will be posted by the BLM ESO in the public room and online at least 45 days before the auction is held.

4.2. Consultation and Coordination

U.S. Fish and Wildlife Service - Michigan Ecological Services Field Office

The BLM sent an email with an Official Species List, shapefiles, a map, and General Design Guidelines to FWS on November 28, 2022, with a “no effect” determination. The BLM determined that the act of leasing the parcel itself would have no effect to Threatened & Endangered species. The FWS responded on November 29, 2022, concurring that the no effect determination fulfilled BLM's requirements under section 7(a)2 of the ESA. However, should development occur in the future because of leasing of these lands and upon receipt of an APD, the BLM would conduct further site-specific section 7 consultation with FWS. While Federal regulations and policies require the BLM to make its public land and resources available on the basis of the principle of multiple use, it is BLM policy to conserve special status species and their habitats, and to ensure that actions authorized by the BLM do not contribute to the need for the species to become listed as Threatened or Endangered by the FWS. Official species lists, whether obtained via IPaC or local FWS offices, are valid for 90 days. On February 6, 2023, the BLM confirmed the results on IPaC by requesting an “updated” official species list for the project that indicated no new threatened or endangered species were added since the original list was requested in November 2022.

Michigan State Historic Preservation Office (SHPO)

A letter was sent to the Michigan SHPO on January 11, 2023, notifying the agency that an expression of interest nominating a parcel for a Federal minerals lease had been received and recommended a finding of “No Historic Properties Affected” by the proposed action of leasing. The Michigan SHPO did not respond to the BLM within the 30-day timeframe pursuant to 36 CFR 800.4(d)(1)(i) and therefore did not raise any objections to the proposed action. If a lease to develop the federal minerals is approved, further consultation with the Michigan SHPO would occur at the APD phase prior to approval of any ground disturbing activities.

Tribal governments consulted:

Lac du Flambeau Band of Lake Superior Chippewa
Little Traverse Bay Bands of Odawa Indians
Pokagon Band of Potawatomi Indians
Saginaw Chippewa Indian Tribe of Michigan
Sault Ste. Marie Tribe of Chippewa Indians
Miami Tribe of Oklahoma
Hannahville Indian Community
Citizen Potawatomi Nation
Ottawa Tribe of Oklahoma
Menominee Indian Tribe of Wisconsin
Forest County Potawatomi Community of Wisconsin
Prairie Band Potawatomi Nation

On December 14, 2022, BLM sent letters to twelve Federally recognized Tribes requesting any issues or concerns the Tribes may have regarding the proposed action. The Pokagon Band of Potawatomi Indians responded on January 19, 2023, that there are no known cultural or historical properties in the Area of Potential Effects (APE) of the lease parcel. As of March 7, 2023, no additional Tribes have responded to BLM's inquiry.

CHAPTER 5. LIST OF PREPARERS

Table 2. List of Preparers

Name	Title	Area of Responsibility
Danielle Donkersloot Nikki Carter	Natural Resources Specialist	Water Resources; Noise, Traffic, Aesthetics and Odor; Vegetation; Wildlife; Prime and Unique Farmlands; Soils; Wastes
Kurt Wadzinski	Planning & Environmental Coordinator	NEPA Compliance; Document Editing and Review
Wes Willoughby	Archaeologist & Tribal Liaison	Cultural Resources; Native American Religious Concerns; Tribal Consultations
Fred Holzel	Geologist	Geology; RFDS; Mineral Resources and Energy Production
Shine Roshan	Socioeconomist (contractor), EMPSi	Socioeconomics; Environmental Justice
Andrew Shroads	Senior Environmental Specialist (contractor), SC&A	Air Quality; Climate Change; Greenhouse Gases; Social Cost of Carbon

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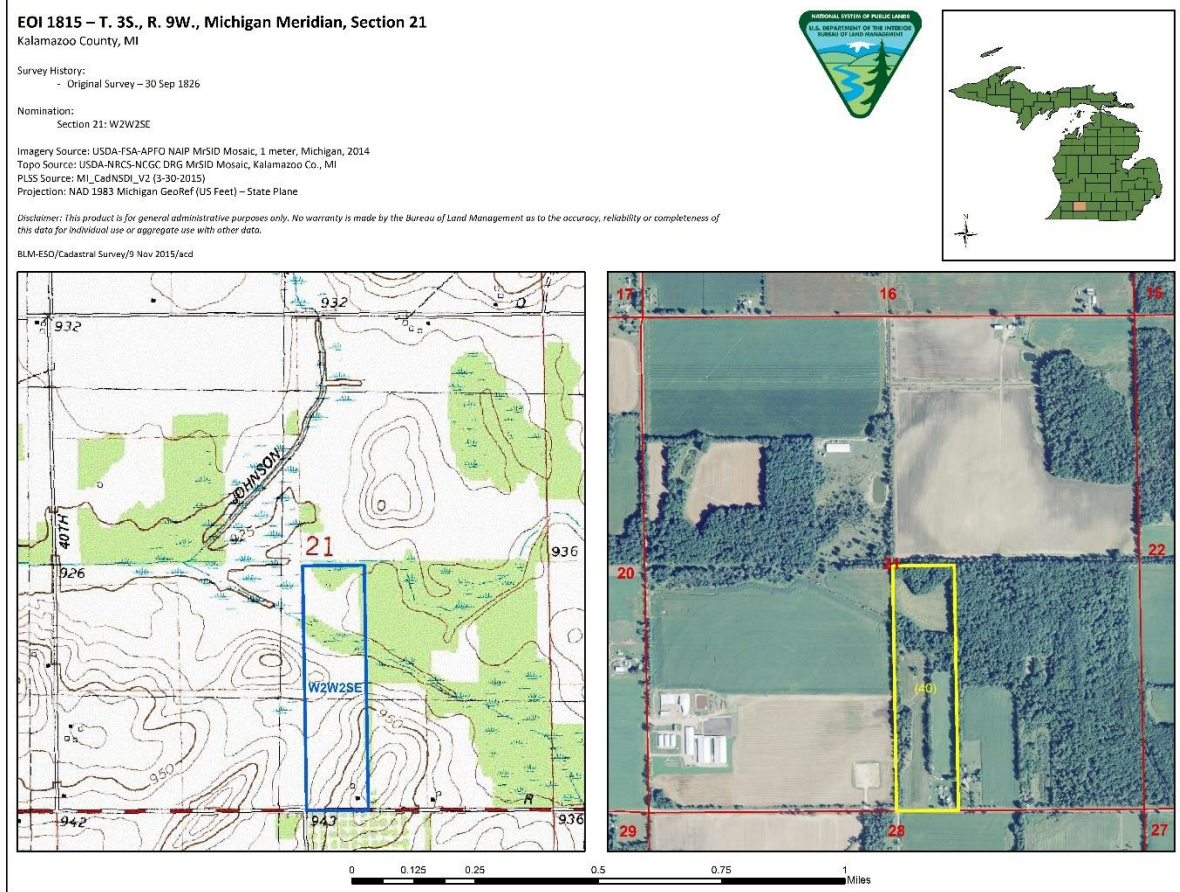
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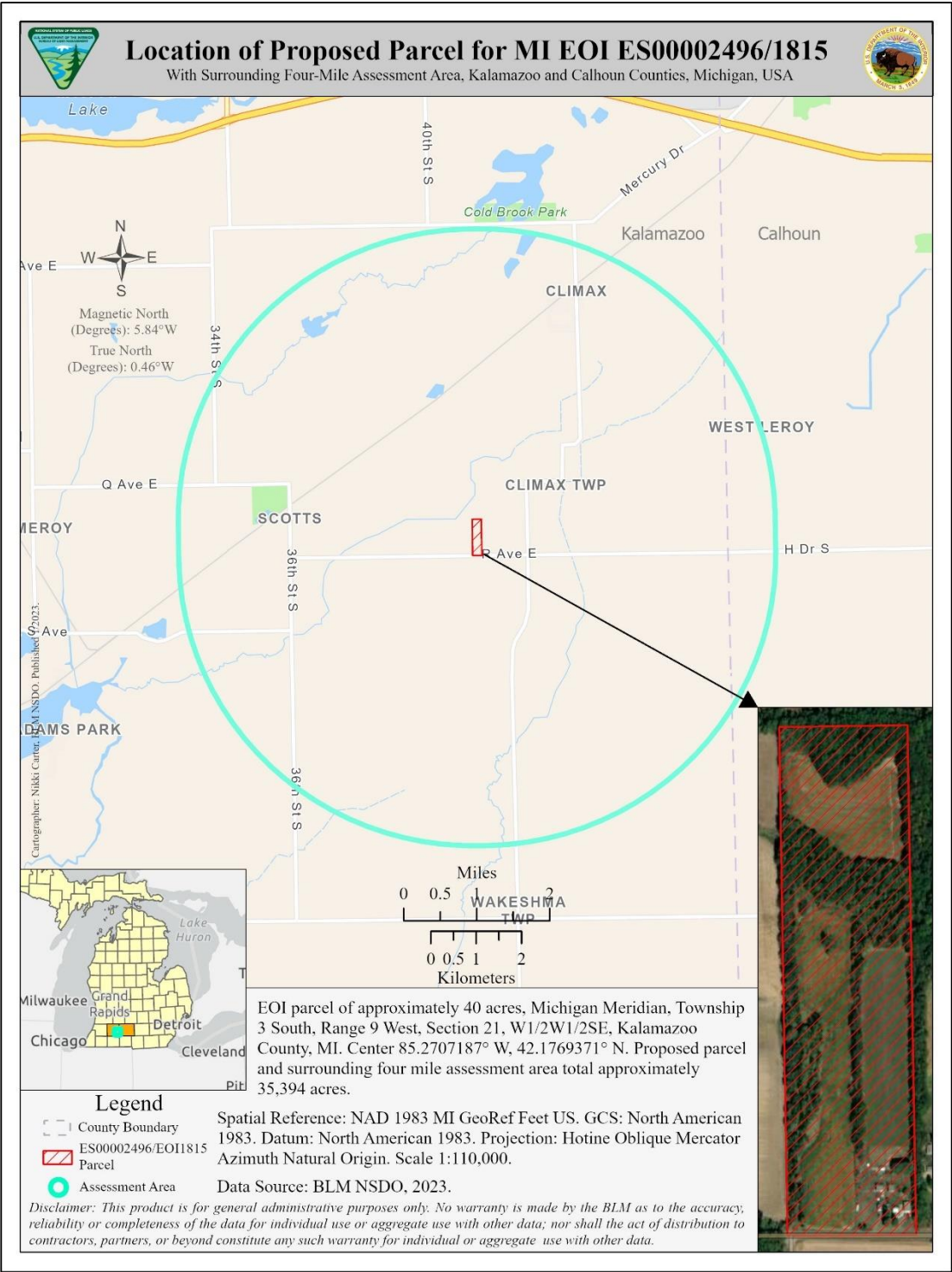
APPENDICES

APPENDIX A: Maps

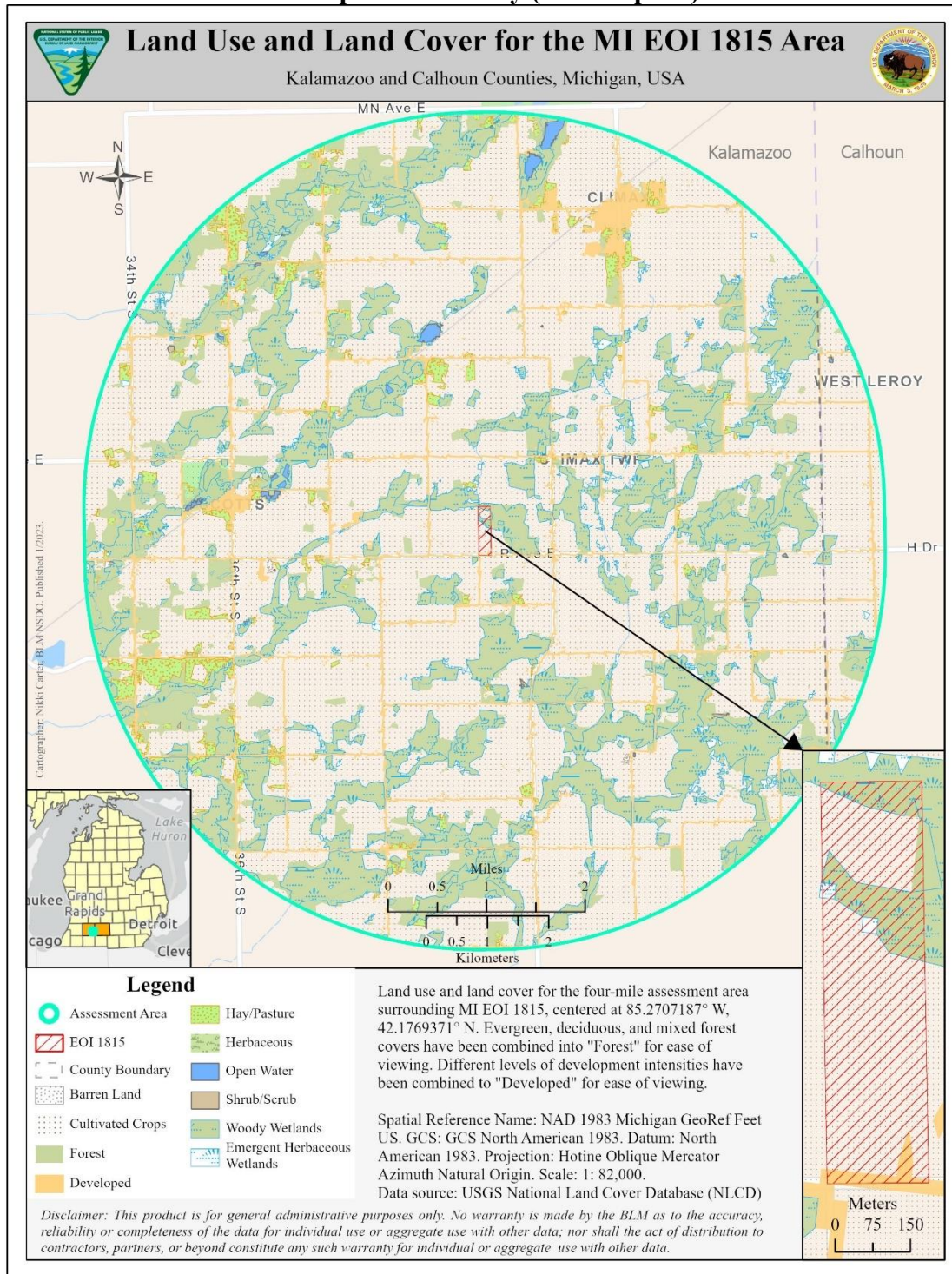
Map 1. Location overview of proposed leased parcel



Map 2. Location overview of proposed lease parcel and surrounding four-mile assessment area

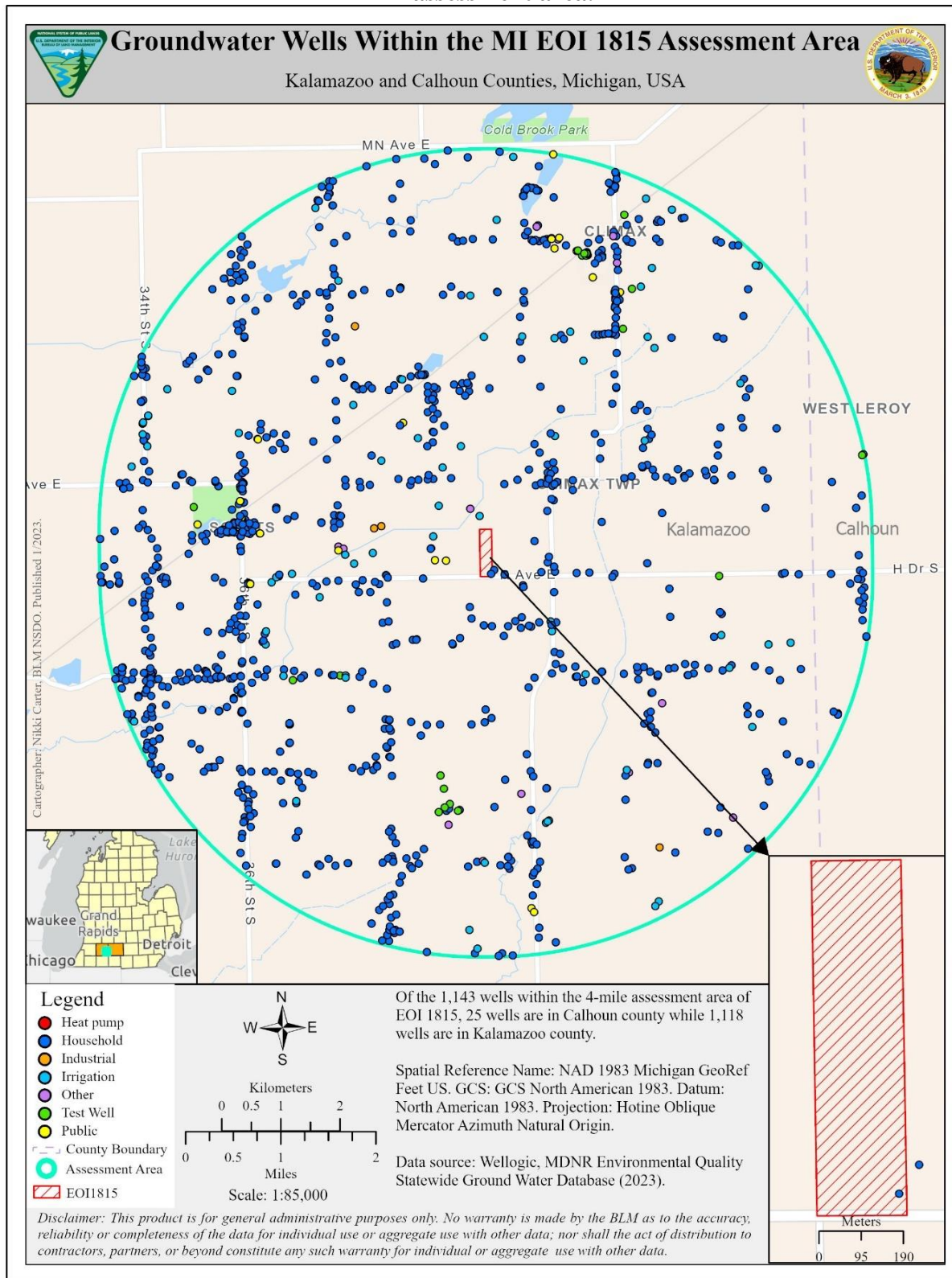


Map 3. Land use and land cover in the EOI and surrounding four-mile assessment area. Forest types were amalgamated to “Forest” for ease of viewing, as were different levels of development intensity (“Developed”).



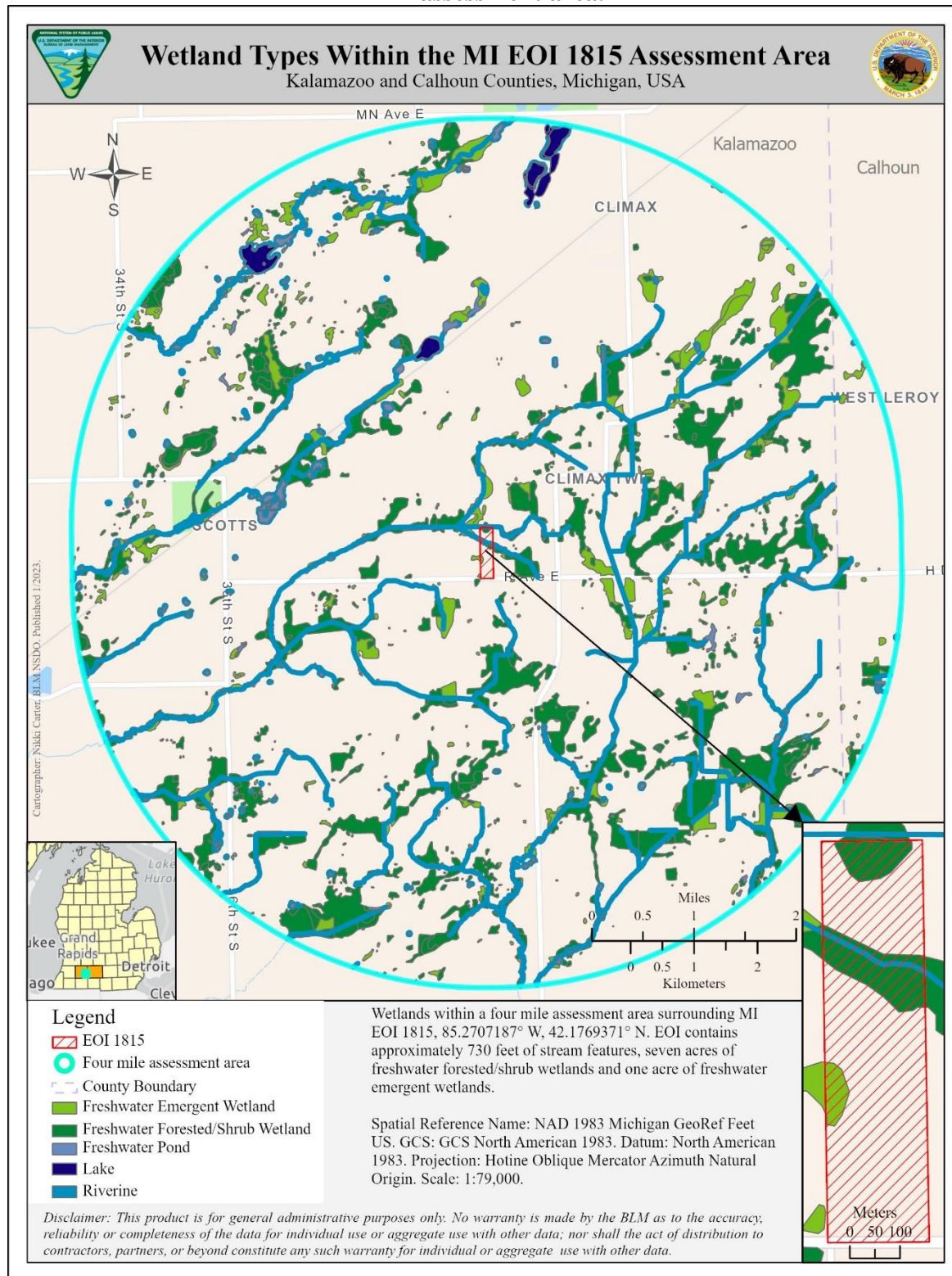
Source: USGS Nation Land Cover Database (NLCD), 2019.

Map 4. Groundwater wells within the proposed lease parcel and surrounding four-mile assessment area.



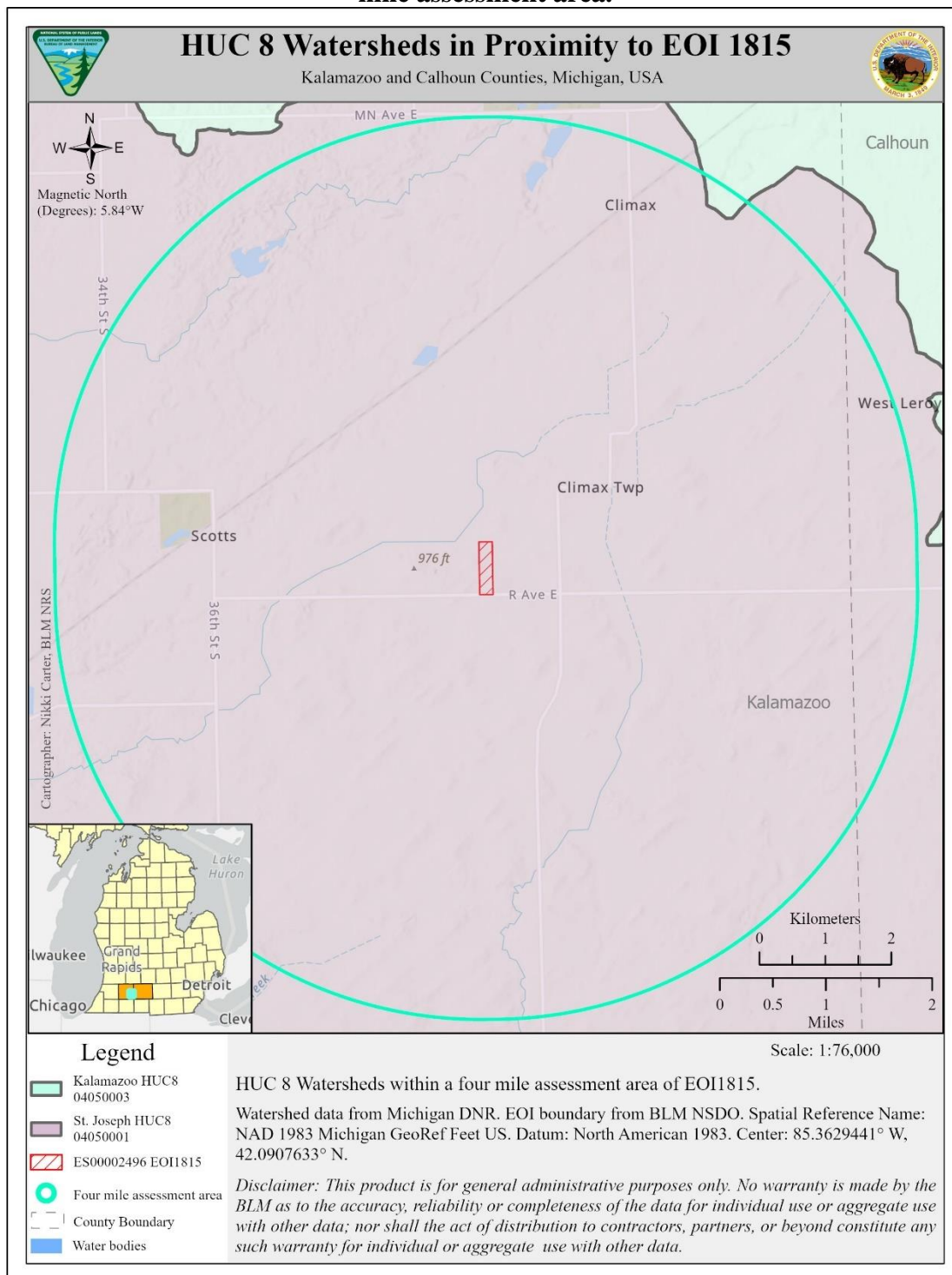
Source: Wellogic, MDNR Environmental Quality Statewide Groundwater Database, 2023.

Map 5. Wetland types within the proposed lease parcel and surrounding four-mile assessment area.



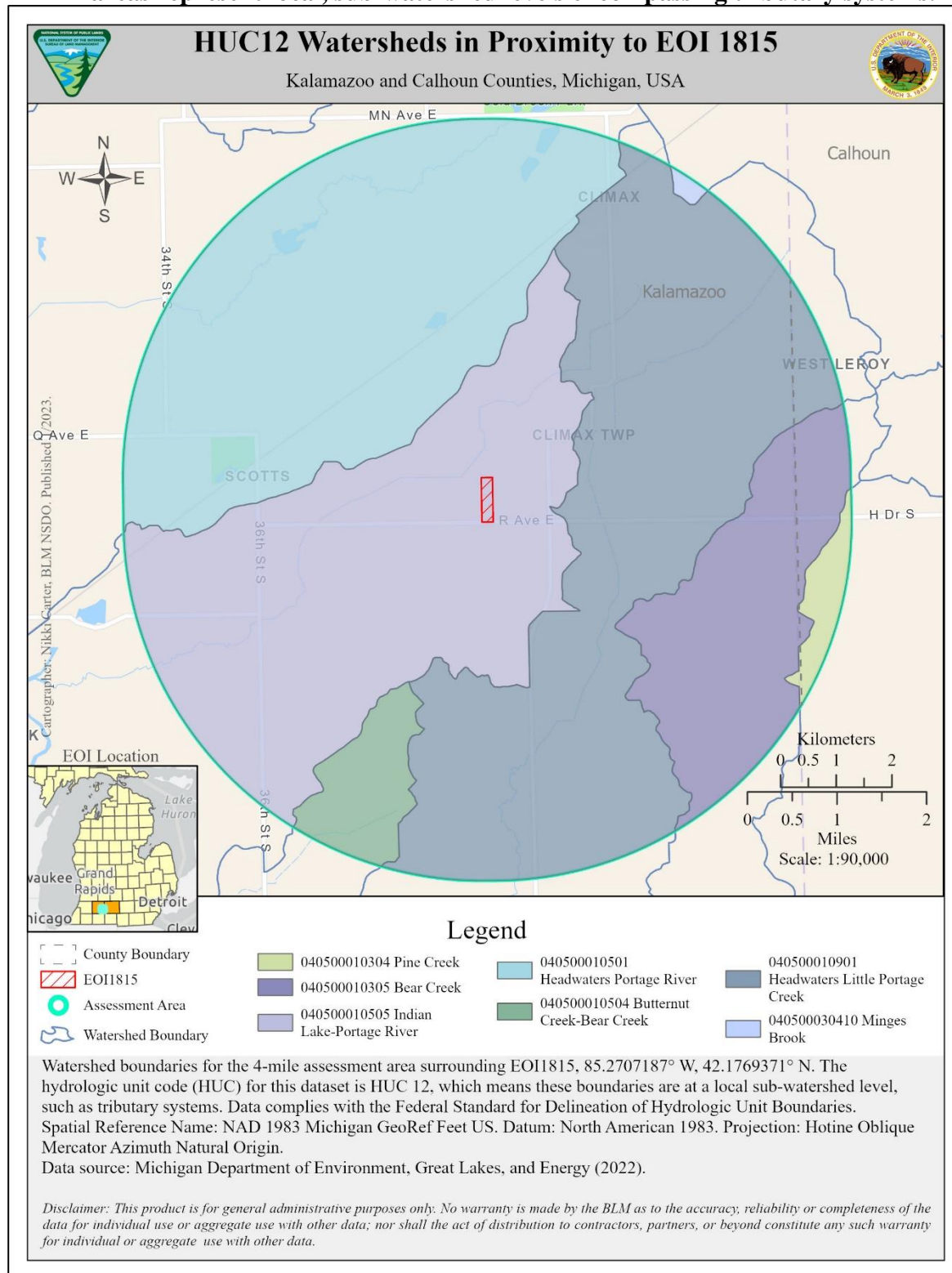
Source: Minnesota DNR (2022) and USFWS National Wildlife Inventory (2022), which utilizes 2005 imagery.

Map 6. HUC 8 watersheds in proximity to the proposed lease parcel and surrounding four-mile assessment area.



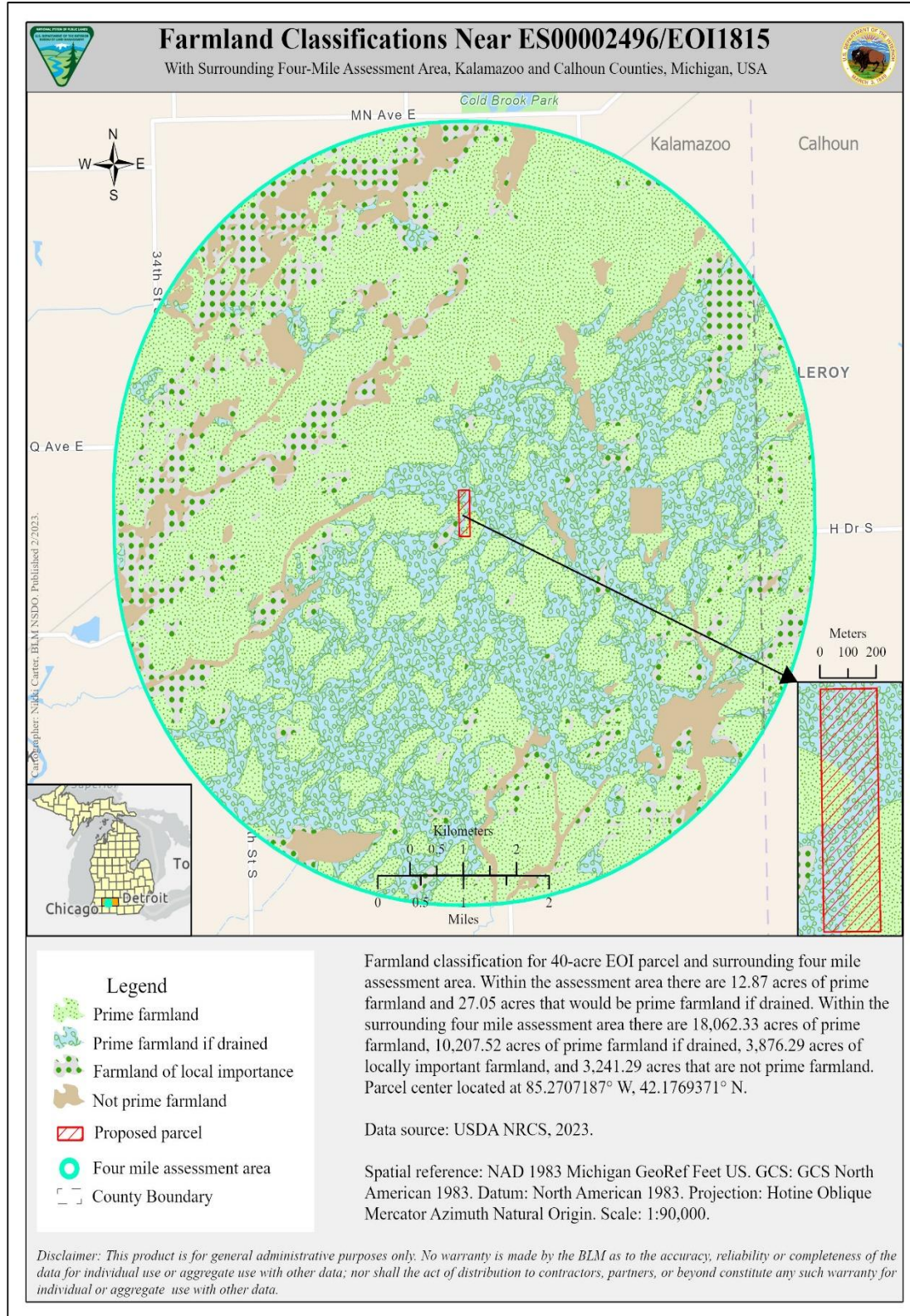
Source: Watershed data from Michigan DNR, 2022.

Map 7. HUC12 watersheds in MI EOI and surrounding four-mile assessment area. These areas represent local, sub-watershed levels encompassing tributary systems.



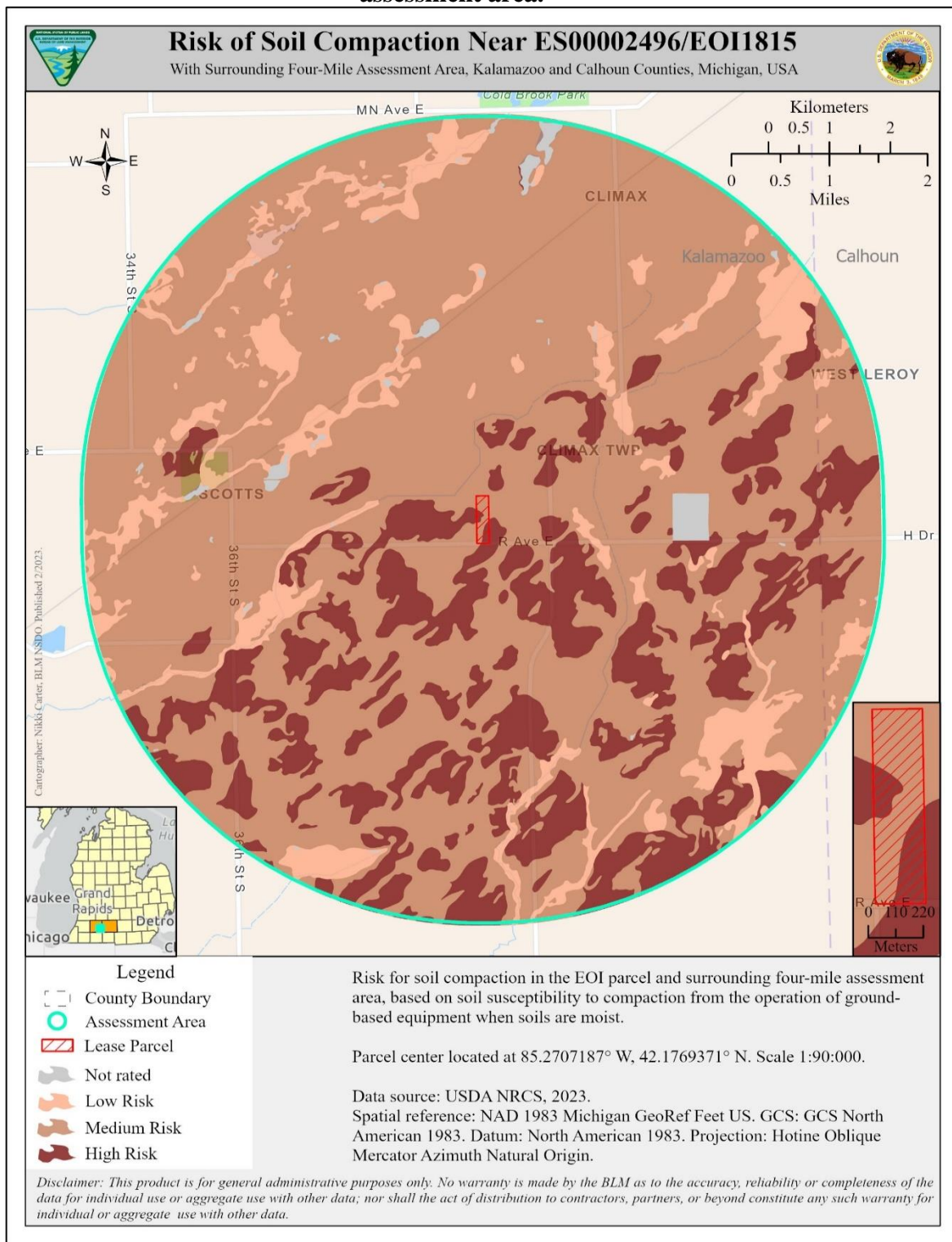
Source: EGLE, 2022

Map 8. Farmland classifications within the proposed lease parcel and surrounding four-mile assessment area.



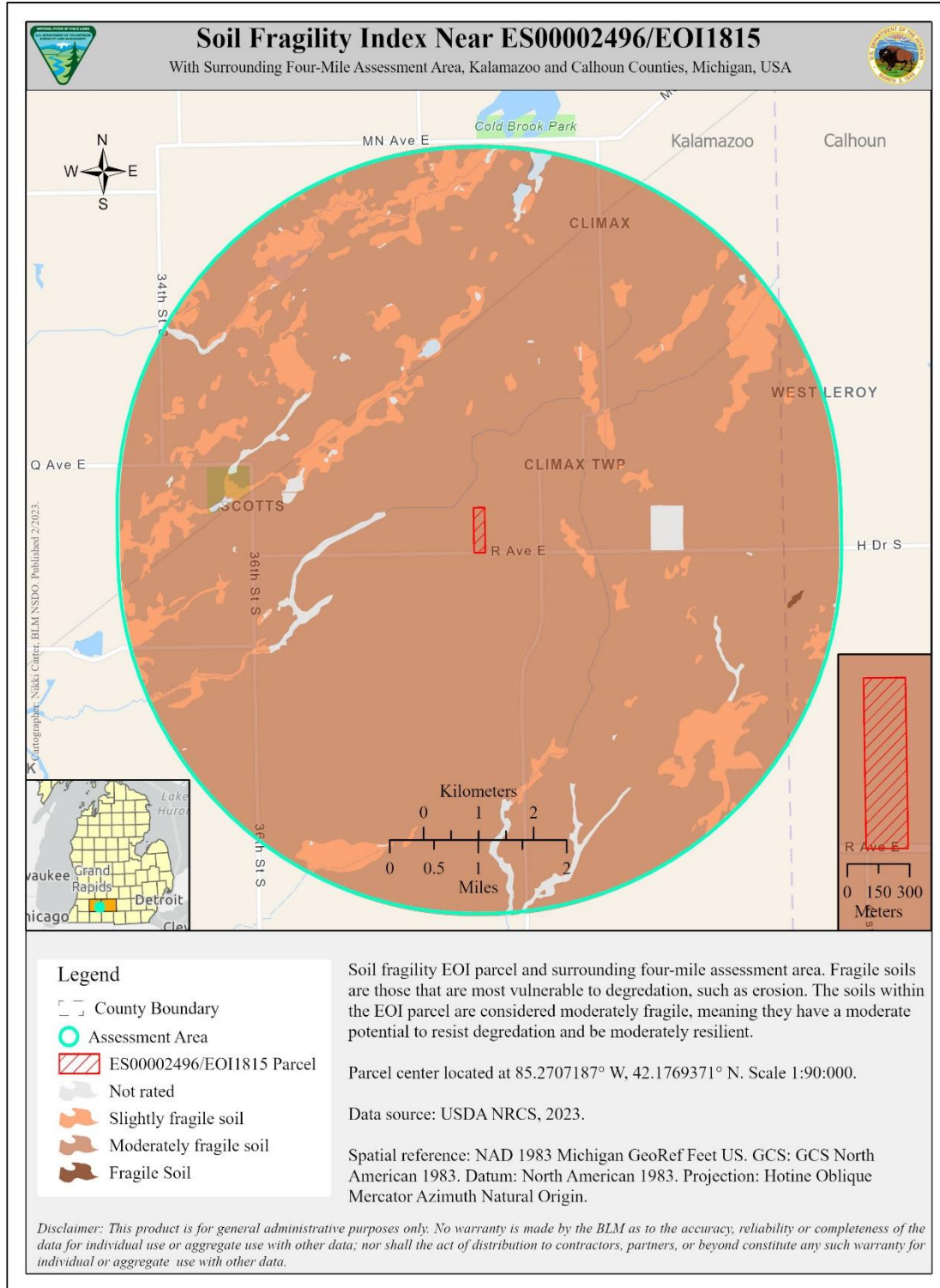
Data from USDA NRCS, 2023.

Map 9. Risk of soil compaction in the proposed lease parcel and surrounding four-mile assessment area.



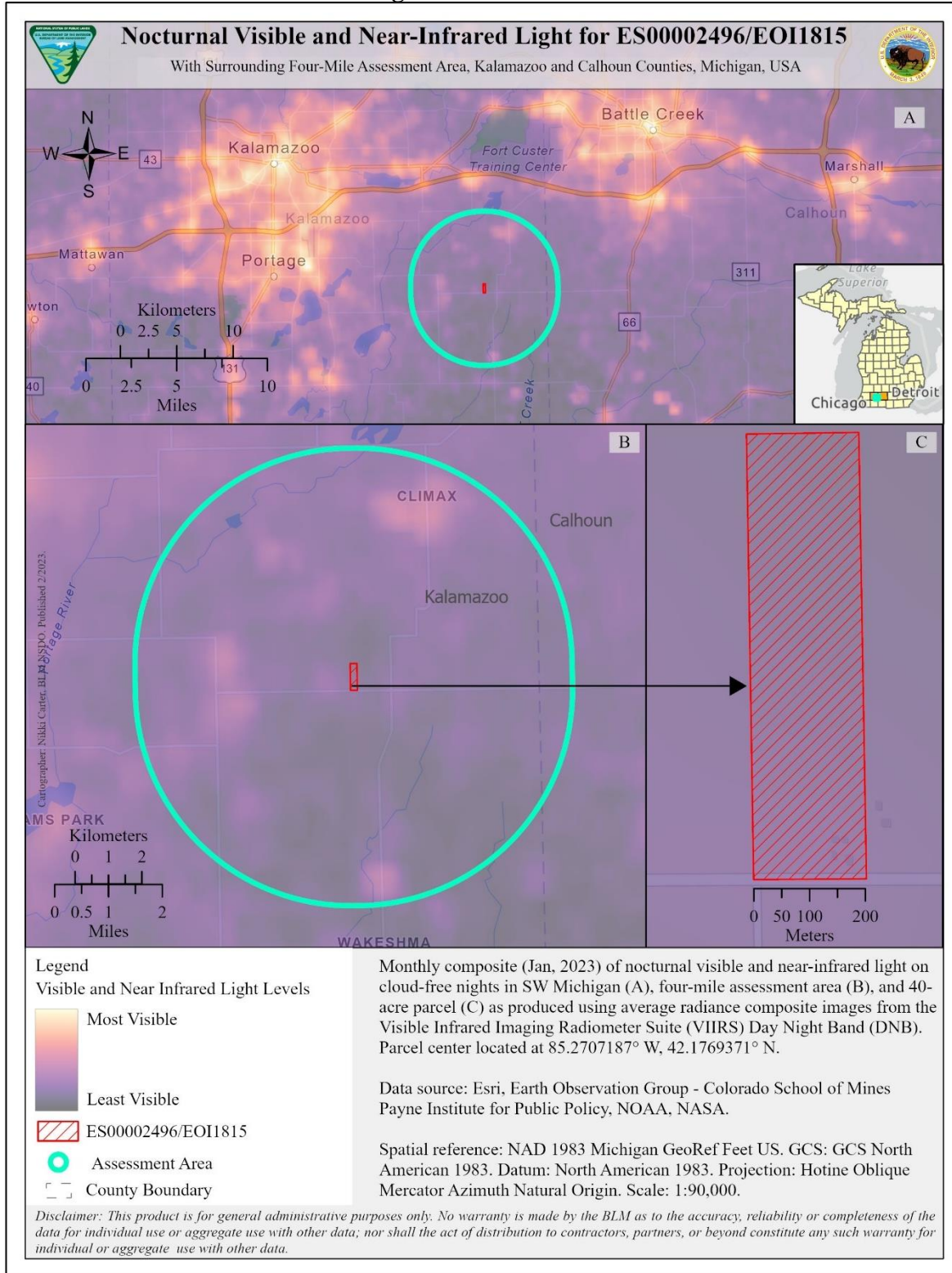
Data from USDA NRCS, 2023.

Map 10. Soil fragility of the proposed lease parcel and surrounding four-mile assessment area.



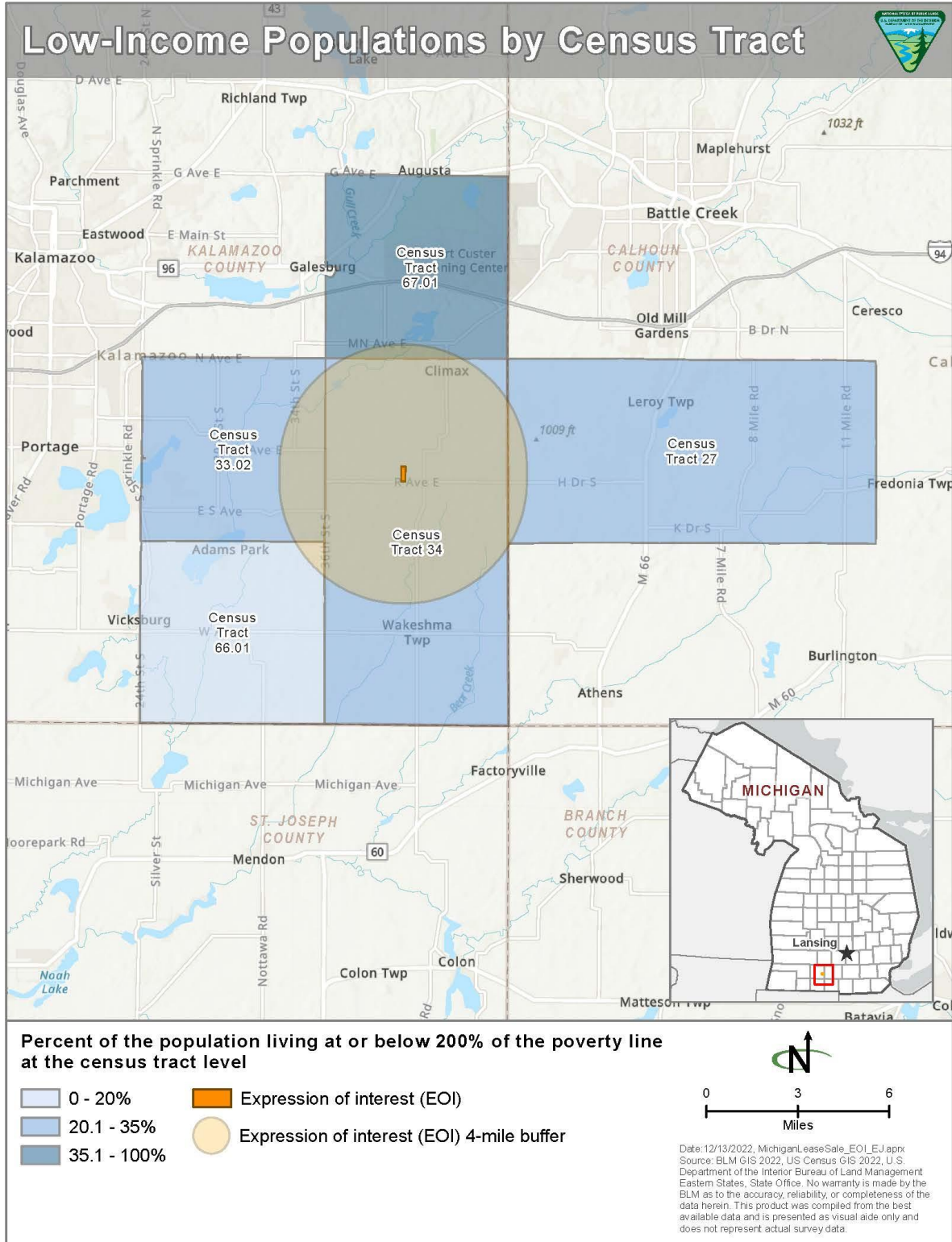
Data source: USDA NRCS, 2023.

Map 11. Nocturnal visible and near-infrared light for the proposed lease parcel and surrounding four-mile assessment area



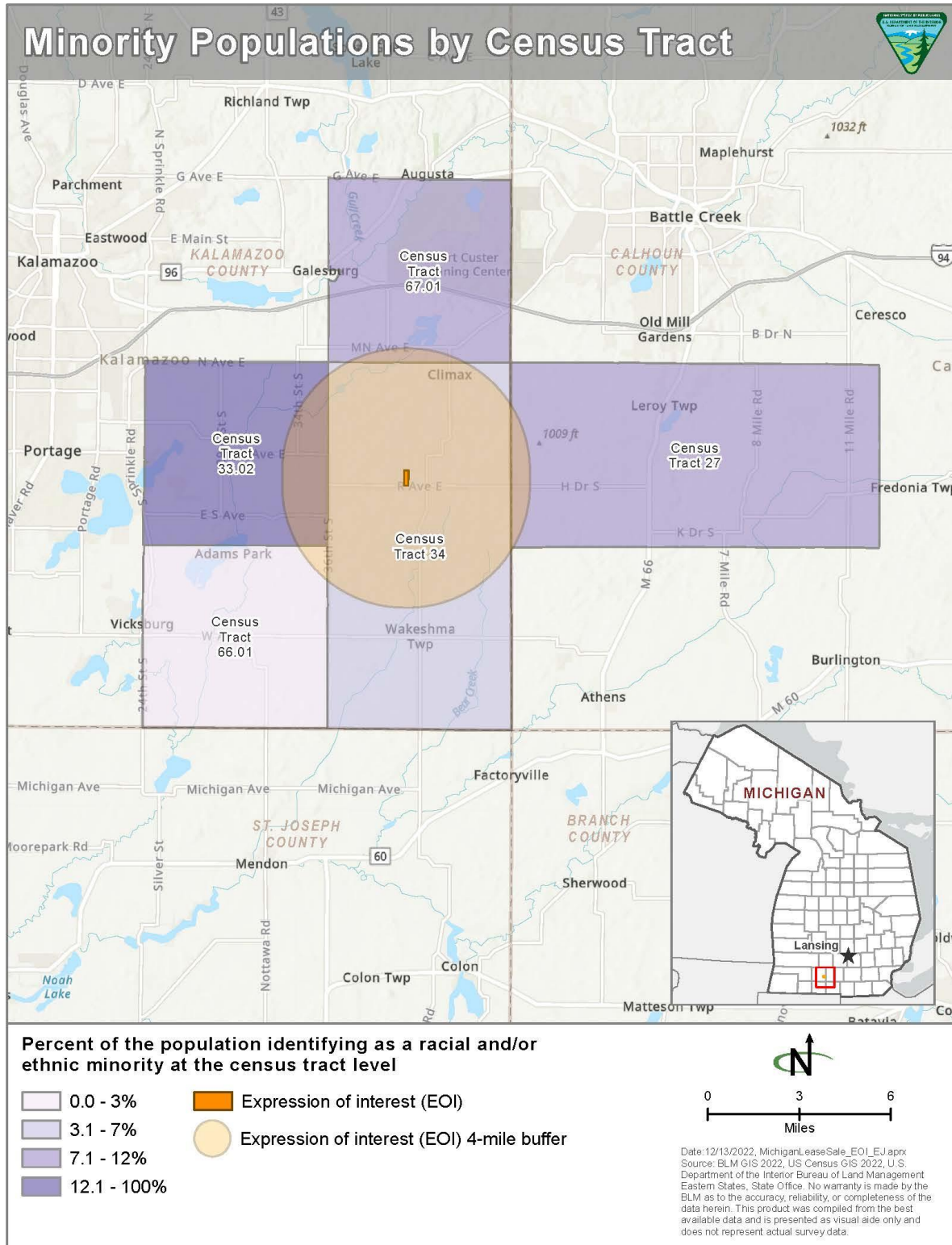
Data source: Esri, Earth Observation Group- Colorado School of Mines Payne Institute for Public Policy, NOAA, and NASA.

Map 12. Low-income populations in the four-mile assessment area, by Census tract



Data Source: U.S. Census Bureau, 2020a

Map 13. Minority populations in the four-mile assessment area, by Census tract



Data Source: U.S. Census Bureau, 2020b

APPENDIX B: Reasonably Foreseeable Development Scenario

**Reasonably Foreseeable Development Scenario
For Oil and Gas Activities**

**Expression of Interest 2496
40-acre Parcel
Kalamazoo County, Michigan**

Prepared By:

FRED HOLZEL Digitally signed by FRED HOLZEL
Date: 2022.11.16 12:09:22 -06'00'

(Signature)

Geologist
(Title)

November 16, 2022
(Date)

Technical Approval:

TREY MITCHELL Digitally signed by TREY
MITCHELL
Date: 2022.11.16 12:11:22 -06'00'

(Signature)

Petroleum Engineer
(Title)

November 16, 2022
(Date)

Management Acknowledgement:

DEREK STROHL Digitally signed by DEREK STROHL
Date: 2022.11.16 12:50:21 -06'00'

(Signature)

Assistant District Manager - Minerals
(Title)

November 16, 2022
(Date)

The Bureau of Land Management is responsible for the stewardship of our public lands. It is committed to manage, protect, and improve these lands in a manner to serve the needs of the American people for all times. Management is based on the principles of multiple use and sustained yield of our nation's resources within a framework of environmental responsibility and scientific technology. These resources include air, fish and wildlife, minerals, paleontological relics, recreation, rangelands, scenic scientific and cultural values, timber, water and wilderness.

Summary

A Reasonably Foreseeable Development Scenario (RFDS) is a projection (scenario) of oil and gas exploration, development, production and reclamation activity for a defined area and specified period. The RFDS projects a baseline scenario of activity assuming all potentially productive areas can be open under standard lease terms and conditions, except those areas designated as closed to leasing by law, land use plan, regulation or executive order. An RFDS is typically developed using a reasonable, technical and scientific estimate of possible oil and gas activity based on the best available information and data at the time of the study. An RFDS is not a prediction of activity; it is a possible reasonable scenario of activity under a specified set of assumptions. The RFDS is a technical report presenting a baseline scenario of unconstrained activity based on geology, resource occurrence potential, past and current leasing, exploration, and development activity, and engineering technology, with consideration of economics and physical limitations on access to resources. An RFDS is not a decision and does not establish or imply any limits or restrictions on development.

This RFDS is being prepared to support an Environmental Assessment (EA) being prepared for an Expression of Interest (EOI) to make available for oil and gas leasing a 40-acre parcel in Kalamazoo County, Michigan. The RFDS analysis included a four-mile assessment area surrounding the 40-acre parcel identified as EOI 2496 (also known as EOI 1815), for Federal leasing. The four-mile assessment area accounts for possible horizontal (unconventional) wells drilled from beyond the subject parcel but potentially extending into the parcel in the subsurface.

Over the next 20 years, the parcel could accommodate up to two well pads. Each well pad has a possibility of either a vertical/directional well or up to 3 horizontal wells, based on resource occurrence potential and 40-acre well spacing requirements and assuming minimal constraints on drilling. Given the size of the parcel and spacing regulations, a possible horizontal (unconventional) well drilled from beyond the subject parcel but potentially extending into the parcel in the subsurface ought prevent one or both on-site well pad locations.

Wells are projected to be primarily oil wells targeting the Trenton Formation which may also produce natural gas. Recent drilling activities within the four-mile assessment area appear focused on the Climax Field and the Trenton Formation. Eight well permits were issued within the four-mile assessment area during the last two years. While not all permits would result in a well actually being drilled or a producing well being developed, if current interest remains similar it is possible up to 80 well permits could be authorized within the four-mile assessment area over the next 20 years.

On the 40-acre parcel, disturbances associated with each new vertical well (pad, access and ancillary features) in the area would be expected to average 3.4 acres. If two separate well pads for vertical (conventional) wells are installed, the disturbance acres would be approximately 6.8 acres. Horizontal (unconventional) wells typically require a larger well pad and are drilled deeper than vertical (conventional) wells. Disturbances associated with a new horizontal (unconventional) well in the area may increase to average 4.32 acres. If two separate well pads each for horizontal (unconventional) wells are installed, the disturbance acres would be approximately 8.64 acres. After a well is installed and developed, some surface disturbance would be recontoured and vegetated and only longer-term disturbance would remain. Longer-term disturbance would exist until all wells on the pad are plugged

and abandoned in accordance with applicable regulations and final reclamation of the site is completed. It is also possible the parcel would be leased for inclusion in a larger drilling unit or communitization agreement and no wells would be drilled on the actual parcel.

Within the four-mile assessment area recent well permits were predominantly for horizontal (unconventional) oil wells. While not all permits would result in actual surface disturbance, if four well pads for horizontal (unconventional) wells were constructed within the four-mile assessment area over the next twenty years, new surface disturbance could be up to 35 acres per year on nonfederal surface and minerals. New surface disturbance within the 20-year period would continually be offset by surface reclamation for non-producing wells and interim reclamation.

Introduction

The Bureau of Land Management (BLM) Northeastern State District, located in Milwaukee, Wisconsin, has jurisdiction over Federal Minerals estates and BLM-administered surface estates in 20 eastern states including Michigan. The Mineral Leasing Act of 1920 and the Mineral Leasing Act for Acquired Lands of 1947 give the BLM responsibility for oil and gas leasing of Federal held mineral estates. The BLM currently holds quarterly oil and gas lease sales when eligible parcels are available for lease.

The BLM received an EOI, an informal nomination, requesting inclusion of a 40-acre Climax Township, Kalamazoo County, Michigan parcel (see Figure 1) in an upcoming oil and gas lease sale. This parcel is non-Federal surface estate and 50 percent Federal minerals estate. The 50 percent Federal mineral interest was acquired under the 1934 Federal Farm Mortgage Corporation Act. The surface of the approximately 40-acre parcel is occupied by cultivated crops (approximately 31 acres), woody wetlands (approximately 7 acres), and one acre of development. Within the four-mile assessment area around the parcel the predominate land covers are cultivated crops, woody wetlands, and deciduous forest. A detailed list of the land cover in the four-mile assessment area can be found in Table 3.11A surrounding four-mile assessment area is predominantly rural with farm/residences, agricultural fields and wooded lands. There is currently no known other Federal surface estate within the four-mile assessment area. Other than the subject parcel, there is currently no known Federal mineral estate within the four-mile assessment area. The nearest Federal Minerals are found slightly greater than four miles either north or south of the parcel. In accordance with Federal leasing procedures, nominated parcels must be reviewed for availability and environmental concerns prior to any sale.

This RFDS is intended to support an Environmental Assessment (EA) to be prepared for this EOI to analyze potential availability and environmental concerns prior to its inclusion in a future oil and gas leasing sale.

This RFDS examines area geology and past and present oil and gas activities to evaluate future potential oil and gas activities on the 40-acre parcel for the next 20 years. This document was compiled in October 2022 from data available through October 1, 2022, via various websites and Federal/state databases. Documents reviewed for this RFDS including a 2011 RFDS for Michigan (BLM, 2011), BLM guidance document *Planning for Fluid Minerals Supplemental Program Guidance (BLM Handbook H-1624-1)* (BLM, 1989a), and *Policy for Reasonably Foreseeable Development Scenario (RFDS) for Oil and Gas (BLM WO IM No. 2004-089)* (BLM, 1989b).

Description of Geology

A description of the state of Michigan and the 40-acre parcels' geology, includes an examination of general physiographic setting, geologic setting and subsurface stratigraphy and structure.

Physiographically, Michigan lies on the boundary of the Laurentian Upland physiographic division and the Interior Plains physiographic division. The majority of Michigan, both the Southern Peninsula and the eastern Upper Peninsula, are in the Eastern Lake Section of the Central Lowland Province. The western

Upper Peninsula is located within the Superior Upland Province. Kalamazoo County is in the Eastern Lake Section of the Central Lowland Province.

The majority of Michigan is overlain by a veneer of glacially derived unconsolidated sediments. The Southern Peninsula is underlain by Paleozoic and Mesozoic age sedimentary rocks. The Southern Peninsula and the eastern Upper Peninsula of Michigan occurs within the Michigan Basin, an intracratonic depositional basin that encompasses the entire Southern Peninsula and the eastern half of the Upper Peninsula in Michigan as well as eastern portions of Wisconsin, northeastern Illinois, northern Indiana, northwestern Ohio, and western Ontario, Canada. The basin is characterized by down warped sedimentary strata (University of Michigan, 2020).

Kalamazoo County occurs within the Michigan Basin. Kalamazoo County is overlain by glacially derived unconsolidated sediments comprising outwash deposits, tills, and moraine landforms. Specifically, the 40-acre parcel is located within the Climax-Scotts Outwash Plain Deposits (Monaghan and Larson, 1982). The deposit typically is comprised of sand and gravel with some cobble and boulder size rocks. Kalamazoo County is underlain by dipping, predominantly marine-derived sedimentary rocks of Paleozoic age (Cambrian through Mississippian periods). Rock types include sandstones (some shaley-limey), limestones (some sandy or shaley), shales (some sandy) and evaporites (such as rock salt and gypsum). The Mississippian age Coldwater Shale is the predominant surface rock beneath the glacial sediments for the 40-acre parcel and the four-mile assessment area. Secondary structural elements of the Michigan Basin include jointing, northwest-southeast trending anticlines and synclines possibly associated with either reactivation of a midcontinent rift system or Paleozoic mountain building episodes to the east (Charpentier, 1988). No major faults or major structures are identified on the 40-acre parcel or within the four-mile assessment area (USGS, 2020).

Oil and Gas Occurrence Potential

Geologically, potential oil and gas occurrences in Michigan are limited to the eastern Upper Peninsula and the Southern Peninsula. The U.S. Geological Survey (USGS) completed assessments of the undiscovered oil and gas potential of each major region of the United States, including the U.S. portion of the Michigan Basin. The assessments defined Total Petroleum Systems (TPS) based on hydrocarbon source rocks, reservoir rocks, and hydrocarbon traps. Within each TPS, Assessment Units (AU) were defined based on the same geologic elements.

The USGS assessment divided oil and gas resources into two distinct types, conventional and continuous. Conventional resources are characterized by individual or discrete structural, stratigraphic, or combination traps. These petroleum hydrocarbon deposits, which may also include water, are separated into distinct layers of water, liquid hydrocarbons, and gas by their immiscibility and relative buoyancies. Continuous accumulations are regional stratigraphic accumulations of hydrocarbons (usually natural gas). These deposits commonly occur in blanket-like sedimentary deposits such as coal (coal-bed methane), organic-rich shales, and low porosity (tight) basin-center sandstones.

In the Michigan Basin, the USGS defined six TPSs, containing a total of 13 AUs (USGS, 2004). The six TPSs are as follows:

- Silurian Niagara/Salina TPS (Silurian Niagara AU, Silurian A-1 Carbonate AU, and Devonian Sylvania Sandstone AU),
- Ordovician to Devonian Composite TPS (Ordovician Trenton/Black River AU, Ordovician Collingwood Shale Gas AU, Silurian Burnt Bluff AU, Middle Devonian Carbonates AU, Devonian Antrim Continuous Oil AU, and Devonian to Mississippian Berea/Michigan Sandstone AU),
- Ordovician Foster TPS (Ordovician Sandstones and Carbonates AU),

- Precambrian Nonesuch TPS (Precambrian Nonesuch AU),
- Pennsylvanian Saginaw TPS (Pennsylvanian Saginaw Coal Bed Gas AU) and
- Devonian Antrim TPS (Devonian Antrim Continuous Gas AU).

The subject parcel and four-mile assessment area included the Ordovician to Devonian Composite TPS and Ordovician Foster TPS.

The oil and gas occurrence potential describes the likelihood of hydrocarbon-containing rocks at the 40-acre parcel and within the four-mile assessment area. Kalamazoo County has had oil and gas production. The potential for continued oil and natural gas production in Kalamazoo County exists with many of the known oil and gas producing formations present, but exploration is expected to fluctuate based on the price of oil and natural gas. Oil and natural gas prices are expected to remain similar for several years and then decrease as supplies increase and other economic conditions improve. After a price decrease, they are expected to slowly increase again over the next twenty years.

Michigan Past and Present Oil and Gas Activity

Statewide, oil and/or natural gas wells were drilled between 1869 and 1898, but little hydrocarbon was found. Michigan's first commercial natural gas well started production in 1911 and the first commercial oil well started in 1925. The state's first oil boom came in 1927 with the Muskegon discovery. During the 1930s, 65 oil and natural gas fields were discovered in Michigan. In the 1940s, exploration focused on shallow and very deep reservoirs and utilized wells with multiple pay zones resulting in new fields being opened, but no new major fields were discovered. In the 1950s, Michigan's largest oil field, the Albion-Pulaski-Scipio Trend producing from the Trenton-Black River carbonate sequence, was discovered. In the early 1980s, advances in brine disposal systems and an emerging interest in using natural gas to generate electricity turned the known but relatively untapped Antrim Shale into a major gas-producing play. Other important finds in the 1980s included the Williams Berea Field and new discoveries in the Black River zone in southern Michigan. The Antrim Shale continued to be the major point of activity in Michigan through the 1990s (Westbrook, 2011). A review of recent drilling permits shows the Niagaran Formations, Trenton Formation and the Black River Formation being among the most actively drilled formations.

Geophysical exploration includes gravity, magnetism and seismographic methods. There is a potential for geophysical exploration occurring on the parcel. The surface estate is not Federal and does not require any Federal notification or permit. The state of Michigan requires a permit under the General Permit for Survey Activities for seismic exploration. It is not known if geophysical exploration occurred or is occurring on non-Federal surfaces within the four-mile assessment area.

Exploratory Drilling

Exploratory drilling is employed to confirm target zones and identify possible impediments to well drilling and completion. Exploratory drilling is classified typically as "wildcat drilling", meaning wells are drilled in an area of no known pool, reservoir or field. Exploration drilling is an ongoing process and activity integral to the oil and gas industry but varies according to changes in oil and natural gas prices, new technologies and other factors.

New Field and Reservoir discoveries

In petroleum geology and exploration, the term "play" refers to a regional group of oil fields or prospects controlled by similar geological parameters. These parameters include specific geologic formations or strata, source rock, structures, traps, seals, tectonic history, reservoir rock type and thermal maturity. The

term play may also be used to describe a specific stratigraphic or structural geologic setting and its associated hydrocarbons. Active fields are currently producing from the A-1 Carbonate, Antrim, Black River, Collingwood, Niagaran and Utica formations (MDEQ, 2019). No new fields or reservoirs discoveries have been reported recently.

Michigan's primary oil and gas producing formations are identified as: Traverse Dolostone, Dundee, Detroit River/Richmond, Niagaran/Salina, Trenton/Black River Formation, Michigan "Stray", Berea Sandstone, Antrim Shale, and Glenwood/St. Peter Sandstone (MDEQ, 2020). Between January 1 and October 1, 2022, the Michigan Department of Environment, Great Lakes, and Energy (EGLE) issued 42 well permits for either oil, gas, saltwater disposal, gas storage or a pilot hole throughout the entire state of Michigan. The 42 wells permits targeted the Amherstburg Formation, Detroit River group, Dundee Limestone, Franconia Formation, Michigan Stray Sandstone, Mount Simon Sandstone, Niagaran, Niagaran Brown Formation, Prairie Du Chien Formation, Traverse Limestone, Trenton Limestone, and the Trenton-Black River Formation. Based on stratigraphy, these formations may be present below the proposed 40-acre parcel.

Kalamazoo County Past and Present Oil and Gas Development Activity

While the 40-acre parcel is not currently identified as being in a current play or field it is likely that a well drilled on or through the parcel would target oil in the Trenton or Trenton-Black River formations and be considered part of the Climax Field. A review of Michigan's oil and gas database identified no oil and gas wells on the subject 40-acre parcel. A total of 77 oil and gas wells identified within the four-mile assessment area were permitted and/or drilled between 1939 and October 1, 2022. Eighteen wells were identified as producing oil, three wells as producing natural gas, three temporarily abandoned, eight permitted/drilling, one saltwater disposal, 44 wells as abandoned, drilled and abandoned, or plugged. Thirteen oil wells were vertical (conventional) or directional and five were horizontal (unconventional) wells. All producing gas wells were vertical (conventional). Two well fields; the Climax and Wakeshma fields, are located within a four-mile radius of the parcel. Wells associated with the Climax Field are located immediate west and south of the 40-acre parcel. Climax Field Wells predominantly are oil wells drilled into the top of the Glenwood Formation but targeted the Trenton or Trenton-Black River formations. Wakeshma Field wells are located approximately two miles south of the parcel and predominantly targeted gas in the Clinton formation.

Oil and gas activity within the four-mile circumference occurred in 1939, between 1985 and 1987, in 2004, and between 2014 and the present. The three Wakeshma Field producing gas wells were all drilled in the 1980s and targeted the Clinton Shale, although drilling logs for several wells reported natural gas shows in the Sylvania or Antrim formations. Within the four-mile assessment area, well depths ranged from approximately 1,800 feet to 2,600 vertical feet (IHS, 2022). In the Climax Field there are eighteen producing oil wells all drilled between 2014 and 2022 and targeted the Trenton Formation or Trenton/Black River Formation. Three oil-producing wells were vertical (conventional), ten were directional wells and five of the eighteen producing oil wells were horizontal (unconventional) wells. The Trenton and Trenton/Black River formations are Ordovician through Silurian in age and within the four-mile assessment area, well depths ranged from approximately 2,500 feet to 3,900 vertical feet (IHS, 2022). Unconventional (horizontal) wells near the 40-acre parcel typically extend up to 2,000 feet horizontally in the target formation. There are currently eight well permits issued in 2021 or 2022 targeting the Trenton Formation that have not been drilled. In the four-mile assessment area other formations that have been targeted for oil and/or natural gas resources in the past include the Traverse, Sylvania and Salina formations.

Kalamazoo County Exploratory Drilling

Exploratory drilling has occurred in Kalamazoo County. Wells drilled within the four-mile assessment area and not located within a recognized oil and gas field, indicates exploratory drilling occurs in the area. Many of the exploratory wells drilled within the four-mile assessment area reportedly did not locate sufficient oil and gas deposits and were abandoned.

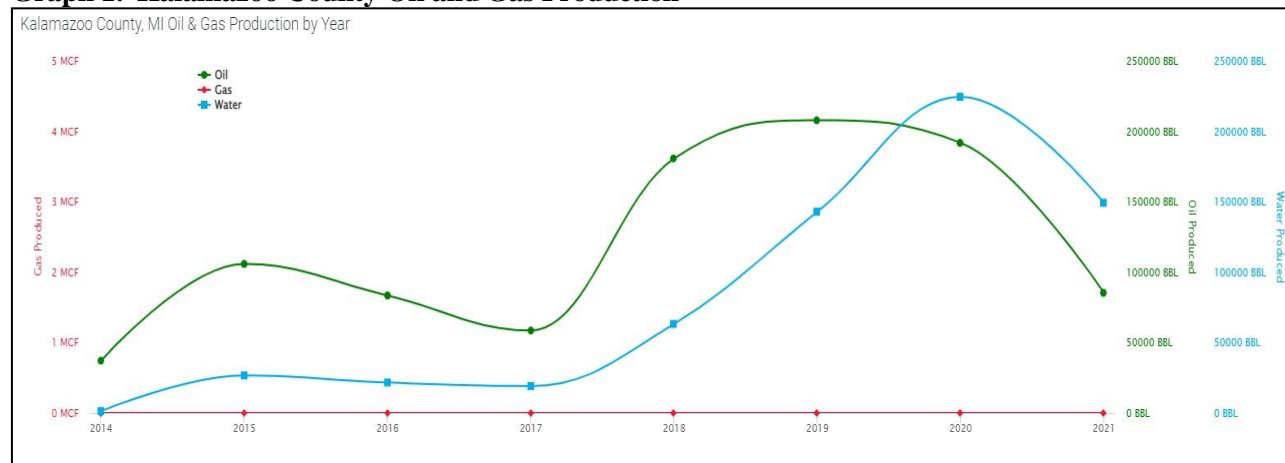
BLM case records indicate no active Federal leases or agreements and thirty-four closed cases in Kalamazoo County Michigan. These cases were opened between 1971 and 1991, and applications were either withdrawn (15 cases), denied or offered for a lease sale without receiving a bid (9 cases), or had a lease authorized (10 cases). All ten authorized leases expired with no drilling activity reported (BLM, 2022d). None of the closed cases included the 40-acre parcel.

Oil and gas development was reviewed for Kalamazoo County (see Table 1 below). Total oil production between 2012 and 2021 was greatest in 2019 and has since dropped in volume. There was no reported natural gas production during this period. Table 1 shows a graph of oil and gas production in Kalamazoo County since 2014. In the last eight years a total of 51 oil and gas wells were drilled in Kalamazoo County. The number of wells drilled in the previous several years is less than a peak of 17 new wells in 2018.

Table 1. Kalamazoo County Oil and Gas Production

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Oil (bbl.)	-	-	37,164	105,848	83,438	58,600	180,709	207,840	191,829	85,339
Natural Gas (mcf)	-	-	0	0	0	0	0	0	0	0
New Wells	0	0	12	1	1	3	17	6	3	8

Graph 1. Kalamazoo County Oil and Gas Production



(MineralAnswers.com, 2022)

Crude oil is generally characterized by the oil's gravity and the presence or absence of any contaminants that may ultimately affect or limit the use of that crude oil in refinery operations. The standard gravity

measurement is termed the API (American Petroleum Institute) gravity. API gravity is defined as: $(141.5 \div SG) - 131.5$, where SG is specific gravity at 60 degrees Fahrenheit. Crude oils are generally termed light or heavy crudes based on the API gravity. A light crude oil is generally one with an API gravity over 40, while very heavy crude oils will typically have an API gravity of 20 or less - the higher the API gravity, the lower the density of the crude oil. Crude oil produced in Michigan has a wide variety of API gravity ratings which vary with depth, the producing reservoir and the geographic location (BLM, 2011).

The annual high and low crude oil and natural gas prices from 2014 through 2021 are shown in Table 2. The price of crude oil generally trended lower from 2012 to 2020, when it experienced a general increase in price in 2021. Natural gas recovered from fields in Michigan ranges from a “wet” gas, which contains some of the heavier fluid hydrocarbons, to “dry” gas with little or no condensate. Antrim Shale gas production tends to be high in nitrogen concentration. Michigan does not produce an appreciable amount of coal-bed methane gas (BLM, 2011). Like oil prices, the price of natural gas fluctuated over this period from 2012 to 2020, with an increase in price in 2021.

Extracted natural gas may be temporarily stored underground in gas storage fields. Gas storage fields are typically located near consumption or production areas and may utilize depleted oil and/or gas fields, aquifer storage fields or salt cavern storage. No natural gas storage fields are located within the four-mile assessment area.

Table 2. Oil and Gas Prices

Prices in US Dollars	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Oil (bbl.)	77.72-	86.65-	53.45-	61.36-	26.19-	42.48-	44.48-	46.31-	11.26-	47.62-
(low-high)	109.39	110.62	107.95	34.55	54.01	60.46	77.41	66.24	63.27	84.65
Natural Gas (mcf)	1.82-	3.08-	2.74-	1.63-	1.49-	2.44-	2.49-	1.75-	1.33-	2.43-
(low-high)	3.77	4.52	8.15	3.32	3.80	3.71	6.24	4.25	3.14	2.86

(Macrotrends, 2022a and 2022b)

Conflicts with Other Mineral Development

Mineral development in Michigan includes a variety of economic rock and mineral resources in addition to oil and gas. Other rock and mineral resources include construction sand and gravel, iron ore, copper, gold, industrial sand and gravel and crushed stone. The only mineral resource identified in Kalamazoo County, other than oil and gas, is sand (MDEQ, 2022). There is no sand and gravel operation on the 40-acre parcel and the nearest sand and gravel operations are located greater than five miles to the north-northeast. A portion of the 40-acre parcel is developed for agriculture and it is unlikely that the surface of the 40-acre parcel would be used for either sand and gravel operation or other mineral development that could conflict with potential oil and gas-related development.

RFD Baseline Scenario Assumptions and Discussion

As mentioned earlier, an RFDS is a scenario of anticipated oil and gas exploration, and/or development activity for a defined area and specified time period and documentation of technical information in the administrative record of any analysis for which it is used. This RFDS provides support information for an environmental assessment being prepared for EOI 2496. This document was prepared for the time period from 2022 to 2042.

The following summarizes baseline scenario assumptions used by the BLM to prepare this RFDS:

- The change in Michigan's production over the forecast horizon (2022 to 2042) will mirror that of the Annual Energy Outlook Reference Case.
- New well pads, access roads and ancillary support facilities (pipelines, storage tanks, metering stations, etc.) may be constructed anywhere within the four-mile assessment area and the 40-acre parcel.
- Industry exploration and extraction of oil and gas would continue to follow a similar pattern of focus on known producing plays underlying the parcel.
- The Federal leasing process would continue relatively unchanged for the next twenty years.
- Multiple unconventional (horizontal) wells may be drilled from a single well pad.
- Oil and gas drilling activities would comply with Michigan regulations.
- Existing roads and facilities would be used where possible and any additional offsite or central facilities for compressors, dehydrators/separators, and storage and metering would be constructed preferentially on private surface.
- Oil and gas exploration, development and production of potentially productive areas are open under the standard lease terms and conditions except those areas designated as closed to leasing by law, regulation, or executive order.
- Deeper unconventional (horizontal) wells would continue being installed at a same or slightly greater rate than shallow conventional wells.
- No new regulations or restrictions to oil and gas development that have not already been implemented or are currently pending, would be implemented.
- Oil and gas drilling and production costs would remain stable with anticipated inflationary increases over the next 20 years.

Surface Disturbance Due to Oil and Gas Activity

Estimates of anticipated surface disturbances associated with the development of oil and gas within the parcel over the period 2022 to 2042 were determined from a variety of resources, including a previous oil and gas RFDS and document reviews. As previously mentioned, assumptions used to evaluate potential surface disturbance include drilling of a single vertical (conventional) well from a single well pad, possible multiple horizontal (unconventional) wells from a single well pad and use of existing roads and facilities (pipelines, storage tanks, metering stations, etc.) where possible.

Michigan well spacing requirements for oil and gas wells drilled are subject to the rules and regulations of Michigan as stated in Part 615 of the Natural Resources and Environmental Protection Act, Act Number 451 of the Public Acts of 1994. Spacing requirements are generally 40-acre spacing. Exceptions to these rules have been ordered by the Supervisor of Wells for some formations. These exceptions are for Antrim Formation wells (80 acres), Niagaran Formation (80 acres), Trenton-Black River Formation (40 acres or two adjacent 20- acre parcels), and Glenwood and lower formation spacing (640 acres) (EGLE, 2020b). Well spacing requirements in the Climax Field are typically 40-acre spacing, corresponding to a quarter-quarter section of a township under the Public Lands Survey System. Given the 40-acre parcel is located partially in two adjacent quarter-quarter sections, with adjacent private owner consent, more than one well pad site is possible on the

40-acre parcel. Accordingly, over the next 20 years, the parcel could accommodate up to two well pads. Each well pad has a possibility of either a vertical/directional well or up to 3 horizontal wells, based on resource occurrence potential, 40-acre well spacing and minimal constraints on drilling. Wells are projected to be primarily oil wells targeting the Trenton Formation, which may also produce natural gas.

The level of disturbance (well pad, access road, soil stockpiles, erosion-control features, guard shacks, etc.) associated with oil and gas development varies depending on the depth of the well and type of well drilled (unconventional or conventional). An earlier RFDS analysis of well pad sizes in the state of Michigan found a shallow vertical oil and/or gas well (generally <2,000 feet deep) typically includes a well pad of 2.0 acres, 0.10 mile of gravel road and 0.55 mile of utility lines for a total construction disturbance area of approximately 2.65 acres. Deeper oil and gas wells (5,000 to 12,000 feet below surface) require a greater disturbance area to accommodate the larger amount of equipment necessary to complete drilling. Usually, an average deeper vertical well may require a 3.25-acre well pad, 0.075 mile of gravel road, and 0.475 mile of utility lines for a total of 3.8 disturbed acres during the construction phase. A single horizontal oil and gas well pad requires a larger well pad of 3.5 acres and the total construction disturbance is estimated to be 6.9 acres (BLM, 2011).

Mr. Mark Snow, manager of permitting and technical services at MEGLE oil, gas and minerals division, reported well pads currently being constructed typically are about two to three acres in disturbance (EGLE, 2022).

In Kalamazoo County thirteen well pads were identified within the four-mile assessment area. Disturbances associated with these pads (pad, access and ancillary features) ranged in size from about 2.4 to 5.7 acres (average disturbance is 3.4 acres). Disturbances associated with each new vertical well (pad, access and ancillary features) in the area average 3.4 acres. If two separate well pads for vertical (conventional) wells are installed, the disturbance acres would be approximately 6.8 acres. Horizontal (unconventional) wells typically require a larger well pad and are drilled deeper than vertical (conventional) wells. Disturbances associated with a new horizontal (unconventional) well (pad, access and ancillary features) in the area may increase to average 4.32 acres. If two separate well pads each for horizontal (unconventional) wells are installed, the disturbance acres would be approximately 8.64 acres. After a well is installed and developed some surface disturbance would be recontoured and vegetated and only longer-term disturbance would remain. Longer-term disturbance would exist until all wells on the pad are plugged and abandoned in accordance with applicable regulations and final reclamation of the site is completed. It is also possible the parcel would be leased for inclusion in a larger drilling unit or communitization agreement and no wells would be drilled on the actual parcel.

Within the last two years, eight new well permits were approved by the State of Michigan within four miles of the 40-acre parcel. While not all permits were developed into producing wells, the permits were for horizontal (unconventional) wells targeting oil in the Trenton Formation. If interest in the area remains the same, four new permits may be issued each year for a total of 80 potential permits in the next 20 years. These 80 new well permits would include those possibly installed on the subject parcel. All of these permits would be on nonfederal surface and mineral estates. While not all permits would result in actual surface disturbance, if four well pads for horizontal (unconventional) wells were constructed within the four-mile assessment area over the next twenty years, new surface disturbance could be up to 35 acres per year on nonfederal surface and minerals. New surface disturbance within the 20-year period would continually be offset by surface reclamation for non-producing wells and interim reclamation.

Potential Revenue Projection

Anticipated revenue generated from oil and gas production on this 40-acre parcel based on the assumption the parcel would be offered as one lease in a 2023 or later competitive lease sale. The first five lease years revenue would be from lease rental fees and the remaining five years to be derived from royalty payments.

Revenue projection for the first five years assumes an administrative fee equal to the first year's advance rental and a bonus bid on not less than \$10.00 per acre. Rentals for a competitive lease is \$3.00 per acre for the first two years, \$5.00 per acre for the following six years and \$15.00 per acre thereafter. For a 40-

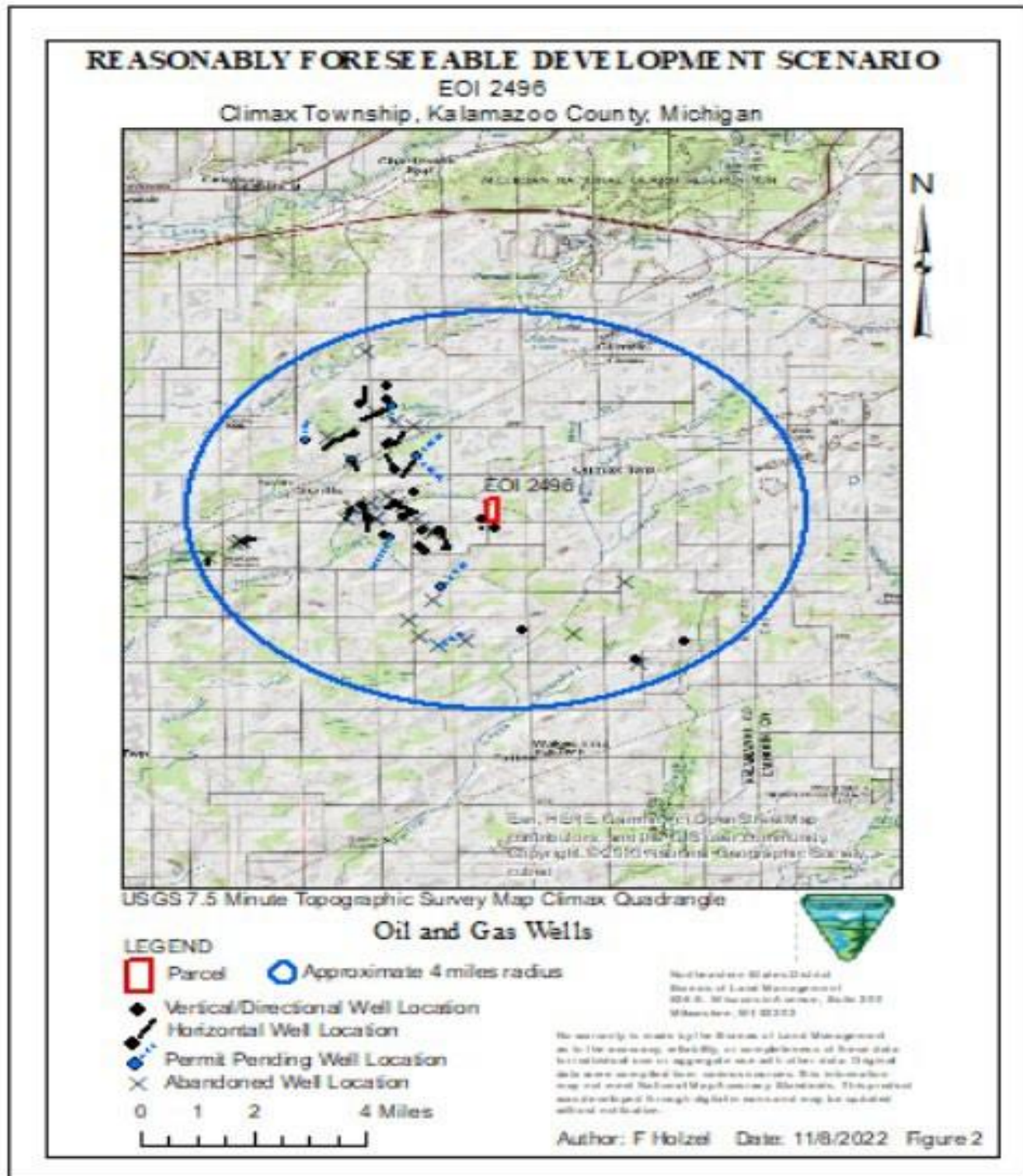
acre lease the revenue projection is estimated to be \$840.00 for the first five years. In accordance with the August 2022 Inflation Reduction Act, royalty rates for oil and gas leasing will be not less than $16 \frac{2}{3}$ percent but not more than $18 \frac{3}{4}$ percent during a ten-year period beginning on the date of enactment of the act.

Anticipated revenue for the second five-year period is based on reviewing recent oil and gas production within a four-mile radius of the parcel and estimating well production on the parcel. While it is not known what formation a possible well may target, a reasonable assumption was made regarding reviewing proximal production. The wells currently active in the Climax Field are producing oil from the Trenton or Trenton Black River formations. Accordingly, any well drilled on or under the 40-acre parcel is anticipated to target oil from these formations.

A review of first year production from seventeen Climax Field Trenton Formation oil wells ranged from 669 to 5,967 barrels per month. On average oil well production decreased every year of production. Production in some wells decreased by more than 50% during the first several years. Given the large range of possible initial production volumes and production decline, it is difficult to assess possible revenue from oil production on the 40-acre parcel. However, any production from a well drilled on this 40-acre parcel should be consistent with these monthly productions. Since only 50% of the minerals are Federal, any revenue due the United States from future production on this 40-acre parcel would be 50% of the standard $16 \frac{2}{3}$ % royalty rate.

Preparer

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Disclaimer: This product is for general administrative purposes only. No warranty is made by the BLM as to the accuracy, reliability, or completeness of the data for individual use or aggregate use with other data; nor shall the act of distribution to contractors, partners or beyond constitute any such warranty for individual or aggregate use with other data.

APPENDIX C: Acronyms and Abbreviations

APD	Application for Permit to Drill
BLM	Bureau of Land Management
BMP	Best Management Practice
CAA	Clean Air Act
CCS	Carbon Capture Sequestration
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CFR	Code of Federal Regulations
CH ₄	Methane
CO	Carbon Monoxide
CO ₂	Carbon Dioxide
CO _{2e}	Carbon Dioxide Equivalent
COA	Conditions of Approval
CWA	Clean Water Act
EA	Environmental Assessment
EO	Executive Order
EOI	Expression of Interest
USEPA	United States Environmental Protection Agency
ESA	Endangered Species Act
GHG	Greenhouse Gas
HUC	Hydraulic Unit Code
NEPA	National Environmental Policy Act
NHPA	National Historic Preservation Act
NO _x	Nitrogen Oxides
RCRA	Resource Conservation and Recovery Act
RFDS	Reasonably Foreseeable Development Scenario
VOC	Volatile Organic Compound

APPENDIX D: Lease Notices and Stipulations

Lease Stipulations

No surface occupancy is permitted within wetlands, as defined in the Clean Water Act, Section 404. The BLM could grant a waiver where the operator is able to obtain all required state and federal permits along with landowner approval.

Cultural Resources Stipulation

This lease may be found to contain historic properties and/or resources protected under the National Historic Preservation Act, American Indian Religious Freedom Act, Native American Graves Protection and Repatriation Act, E.O. 13007, or other statutes and executive orders. The BLM will not approve any ground disturbing activities that may affect any such properties or resources until it completes its obligations under applicable requirements of the National Historic Preservation Act (NHPA) and other authorities. The BLM may require modification to exploration or development proposals to protect such properties or disapprove any activity that is likely to result in adverse effects that cannot be successfully avoided, minimized, or mitigated.

Endangered Species Act Stipulation

The lease may now and hereafter contain plants, animals, and their habitats determined to be special status species. The BLM may recommend modifications to exploration and development proposals to further its conservation and management objectives to avoid BLM approved activity that will contribute to a need to list such a species or their habitat. The BLM may require modification to or disapprove proposed activity that is likely to result in jeopardy to the continued existence of a proposed or listed threatened or endangered species or result in the destruction or adverse modification of a designated or proposed critical habitat. The BLM will not approve any ground-disturbing activity that may affect any such species or critical habitat until it completes its obligation under requirements of the Endangered Species Act as amended, 16 U. S. C. § 1531 *et seq.* including completion of any required procedure for conference.